

# **REPOWERING KIT**

# **MAINTENANCE MANUAL**

for

MODEL

## **PD- 4501**

MARCH 1962

**MARMON-HERRINGTON COMPANY, INC.**

**1511 WEST WASHINGTON STREET**

**INDIANAPOLIS 7, INDIANA**

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## INSTRUCTIONS FOR USE OF THIS MANUAL

This manual must be used in conjunction with Maintenance Manual X-5822 for Model PD-4501. Only those components furnished in the Marmon-Herrington repowering kit are covered herein.

Sections not affected by the repowering kit are not mentioned in this manual.

Where similarity of components warrants, we have referred to sections of Maintenance Manual X-6114 for Model PD-4106. Such reference eliminates many pages of duplicate information thereby keeping the manuals simplified, condensed, and compatible.

MARMON-HERRINGTON COMPANY, INC.  
1511 West Washington Street  
Indianapolis 7, Indiana



# REAR AXLE

For information not listed herein, refer to Maintenance Manual X-5822 for Model PD-4501

Sec. 2 Pages 1 thru 19

Information is applicable except:

Specifications on Page 19 must be supplemented as follows:

Delete ratios shown and add

Ring Gear & Pinion	940099
RATIO	3.7 to 1

## BODY

For information not listed herein, refer to Maintenance Manual X-5822 for Model PD-4501

### Sec. 3A Page 5

Information is applicable except:

#### Engine Compartment Side Closure Doors;

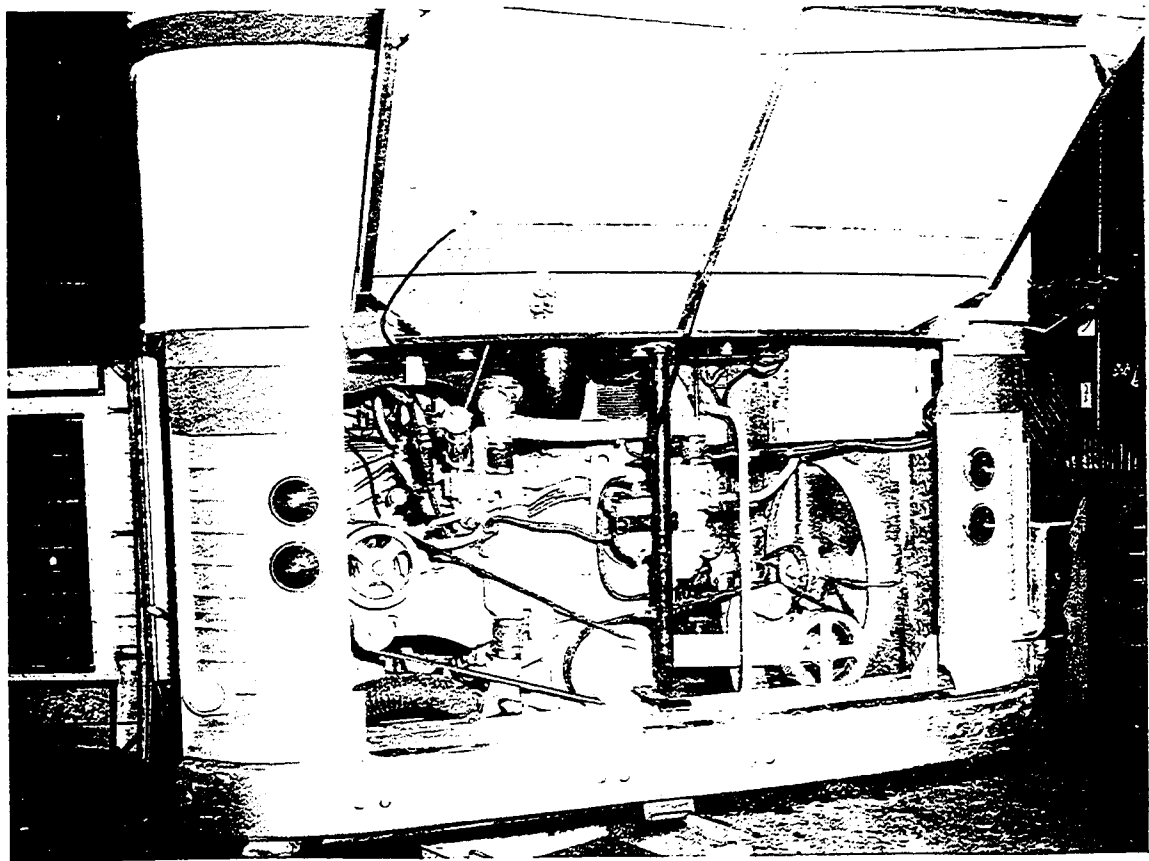
1. The left side closure door conceals the engine cooling system radiator. This door is hinged at the front and pivots from rear to front. After opening door the lock pin can be removed, the spring loaded latch lever released, and the radiator core swung out and to the rear. The core is hinged on the cradle rear upright. A stop for radiator when in out position is provided.

#### Engine Compartment Rear Closure Door:

1. The single rear door is hinged at the top and can be raised and secured for access to the engine compartment. Radiator cores and other equipment are no longer attached to the rear door.

#### Engine Compartment Corner Panels:

1. Fixed corner panels adjacent to center door are provided on both left and right sides of center door.



## AIR COMPRESSOR AND GOVERNOR

AIR COMPRESSOR

For all Air Compressor operating procedures, maintenance and specifications, see Sec. 4 pages 31 thru 41 of PD-4106 Maintenance Manual X-6114.

AIR GOVERNORDESCRIPTION

1. The governor, operating in conjunction with the compressor unloading mechanism, automatically controls the air pressure in the air brake or air supply system between the desired, predetermined maximum and minimum pressures. The compressor runs continually while the engine runs, but the actual compression of air is controlled by the governor which stops or starts compression when the maximum or minimum reservoir pressures are reached. The D-2 governor has a piston upon which air pressure acts to overcome the pressure setting spring and control the inlet and exhaust valve to either admit or exhaust air to or from the compressor unloading mechanism.

OPERATION

1. Reservoir air pressure enters the D-2 governor at one of its reservoir ports and acts on the area of the piston and beneath the inlet and exhaust valve. As the air pressure builds up the piston moves against the resistance of the pressure setting spring. The piston and inlet and exhaust valve move up when the reservoir air pressure reaches the cut-out setting of the governor. The exhaust stem seats on the inlet and exhaust valve and then the inlet passage opens. Reservoir air pressure then flows by the open inlet valve, through the passage in the piston and out the unloader port to the compressor unloading mechanism. The air, besides flowing to the compressor unloading mechanism, also flows around the piston and acts on the additional area of the piston. This additive force which results from a larger area on the piston assures a positive action and fully opens the inlet valve.
2. As the system reservoir air pressure drops to the cut-in setting of the governor, the force exerted by the air pressure on the piston will be reduced so that the pressure setting spring will move the piston down. The inlet valve will close and the exhaust will open. With the exhaust open, the air in the unloader line will escape back through the piston, through the exhaust stem and out the exhaust port.

PREVENTIVE MAINTENANCEEvery 500 Operating Hours or After 15,000 Miles

Clean or replace governor filters. If cleaning, use a cleaning solvent which is known to have no detrimental effect on metal or rubber material. If filters are removed they should be replaced with new filters.

## AIRCOMPRESSOR GOVERNOR

### PREVENTIVE MAINTENANCE (cont.)

Every 3,000 Operating Hours or After 100,000 Miles

Disassemble the Type D-2 governor and clean and inspect all parts.

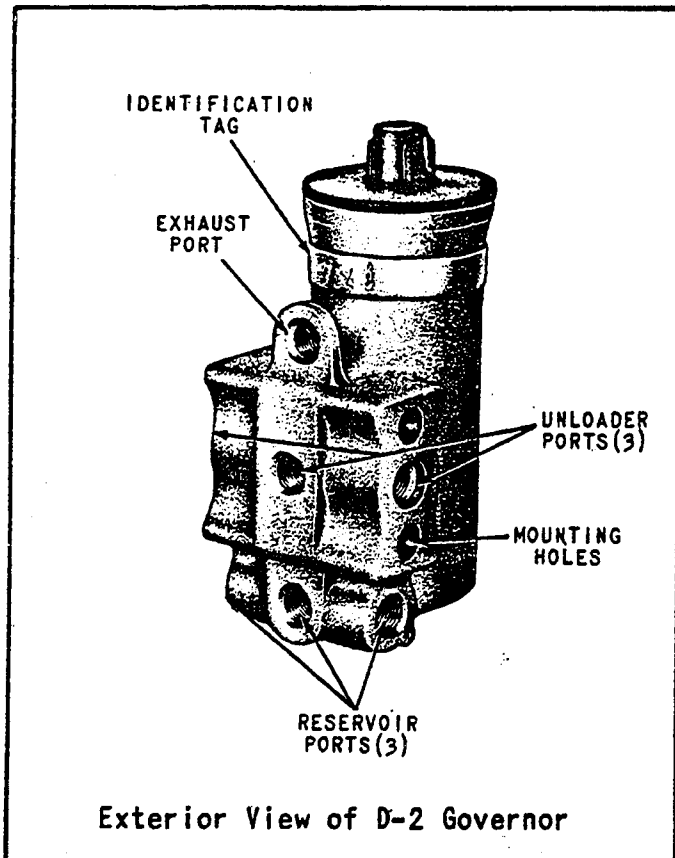


Fig. 1

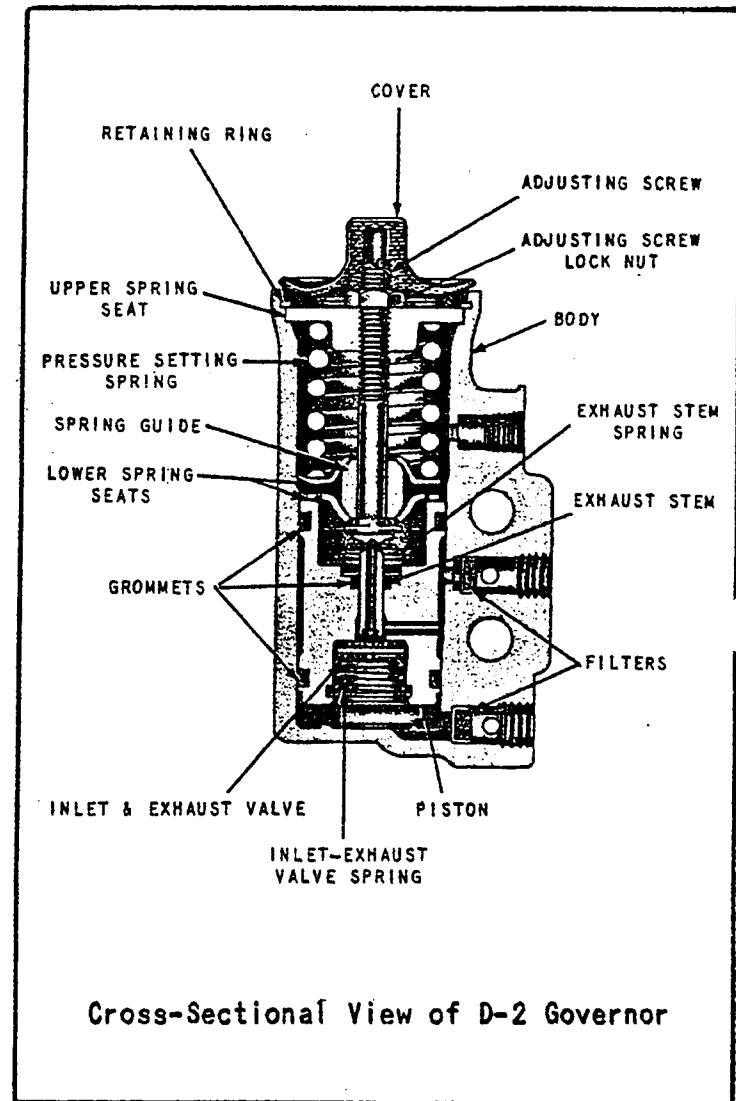


Fig. 2

### SERVICE CHECKS

#### OPERATING

1. Start the vehicle engine and build up air pressure in the air brake system and check the pressure registered by a dash or test gauge at the time the governor cuts-out, stopping the compression of air by the compressor. The cut-out pressure should be in accordance with the piece number of the governor. The more common cut-out pressures vary between 105-125 psi.

## AIR COMPRESSOR GOVERNOR

SERVICE CHECKS (cont.)

2. With the engine still running, make a series of brake applications to reduce the air pressure and observe at what pressure the governor cuts-in the compressor. As in the case of the cut-out pressure, the cut-in pressure should be in accordance with the governor piece number. Common cut-in pressures vary between 80-100 psi. Never condemn or adjust the governor pressure settings unless unless they are checked with an accurate test gauge or a dash gauge that is registering accurately. If the pressure settings of the Type D-2 governor are inaccurate or it is necessary that they be changed, the procedure is as follows.
3. First, unscrew the cover at the top of the governor. Next, loosen the adjusting screw locknut. With a screwdriver the adjusting screw is turned counter-clockwise to raise the pressure settings and the screw is turned clockwise to lower the pressure setting. After the adjustment is completed, the adjusting screw locknut should be tightened to lock this adjustment.

LEAKAGE TEST

1. Leakage checks on the D-2 governor are made at its exhaust port in both cut-in and cut-out positions. In the cut-in position, check exhaust port for inlet valve leakage by applying a soap solution at the port. Leakage could also be past the bottom piston grommet. In the cut-out position check the exhaust port to determine leakage at the exhaust valve seat or stem grommet. In this position leakage could also be past the upper piston grommet.
2. If the governor does not function as described, or leakage is excessive, it is recommended that it be returned to the nearest Bendix-Westinghouse authorized distributor for a factory rebuilt governor under the repair exchange plan. If this is not possible, the governor can be repaired with genuine Bendix-Westinghouse parts, in which case the following should be helpful.

REMOVING AND INSTALLINGREMOVING

1. Block and hold vehicle by means other than air brakes.
2. Drain air brake system. If governor is compressor-mounted type disconnect reservoir air line.
3. If remote-mounted governor, disconnect both the unloader and reservoir air lines.
4. Remove governor mounting bolts, then governor.

INSTALLING

1. If compressor-mounted type governor, clean mounting pad on both compressor and governor block. Clean connecting line, or lines. Also be sure compressor unloading port is clear and clean.

AIR COMPRESSOR GOVERNOR  
--  
REMOVING AND INSTALLING (cont.)

2. If the governor is being mounted remotely, it should be positioned so that its exhaust port points down. It should be mounted higher than the compressor so that its connecting lines will drain away from the governor.
3. Install governor. If compressor-mounted type use a new governor mounting gasket.
4. Connect air lines to governor. Test governor as outlined under Service Checks.

DISASSEMBLY

1. Clean governor exterior of road dirt and grease using a good cleaning solvent and brush.
2. Unscrew the top cover.
3. With a pair of retaining ring pliers, remove the spring assembly retaining ring.
4. Remove the adjusting screw and spring assembly.
5. Remove the lock nut, then the hex-shaped upper spring seat from the adjusting screw.
6. Remove the pressure setting spring, lower spring seat, spring guide and the other lower spring seat from the adjusting screw.
7. Remove the exhaust stem and its spring from the top of the piston.
8. With the body in the inverted position, tap it lightly and the piston should fall out.
9. Remove the inlet and exhaust valve spring and the valve from the piston.
10. Remove the two piston grommets and with a hooked wire remove the exhaust stem grommet.
11. Clean or remove the unloader and reservoir port filters.

CLEANING AND INSPECTION

1. Clean all metal parts in a good cleaning solvent.
2. Wipe rubber parts dry.
3. Inspect body for cracks or other damage. Be particularly careful that all air passages in the body, filters exhaust stem, and the piston are not obstructed.
4. Check springs for cracks, distortion, or corrosion.
5. Replace all parts not considered serviceable during these inspections.

ASSEMBLY

1. Prior to assembly lubricate the lower body bore, the top of the piston, the piston grooves, piston grommets, piston setting spring guide and adjusting screw with recommended Bendix-Westinghouse lubricant, piece number 240176 (BW-204-M).
2. Install the exhaust stem grommet in its groove in the stem bore of the piston.
3. Drop the inlet and exhaust valve into place at the bottom of the piston.

## AIR COMPRESSOR GOVERNOR

## ASSEMBLY (cont.)

--

4. Install the inlet valve spring with its narrow end against the valve. Press the spring down until the large coiled end snaps into the groove inside the piston.
5. Position the exhaust stem spring over the exhaust stem. Then carefully press the stem into the stem bore of the piston.
6. Install the piston in the body.
7. Install one lower spring seat, spring guide, the other lower spring seat, pressure setting spring and the hex-shaped upper spring seat on the adjusting screw, in that order. Screw the upper spring seat down until the dimension from the top of the seat to the bottom of the stem head is approximately 1-7/8".
8. Install the lock nut.
9. Before placing the adjusting screw and stem assembly in the governor body, check to be sure the exhaust stem and its spring are in place in the piston.
10. Install the adjusting screw and spring assembly retaining ring.
11. At this point, make the adjustment as outlined under Service Checks section.
12. After the adjustment is made, then the top cover should be screwed on tightly until it seals the body against the entrance of any foreign matter.
13. If necessary, install new filters in the reservoir and unloader ports. These cup-shaped filters can be installed with the head of a pencil.

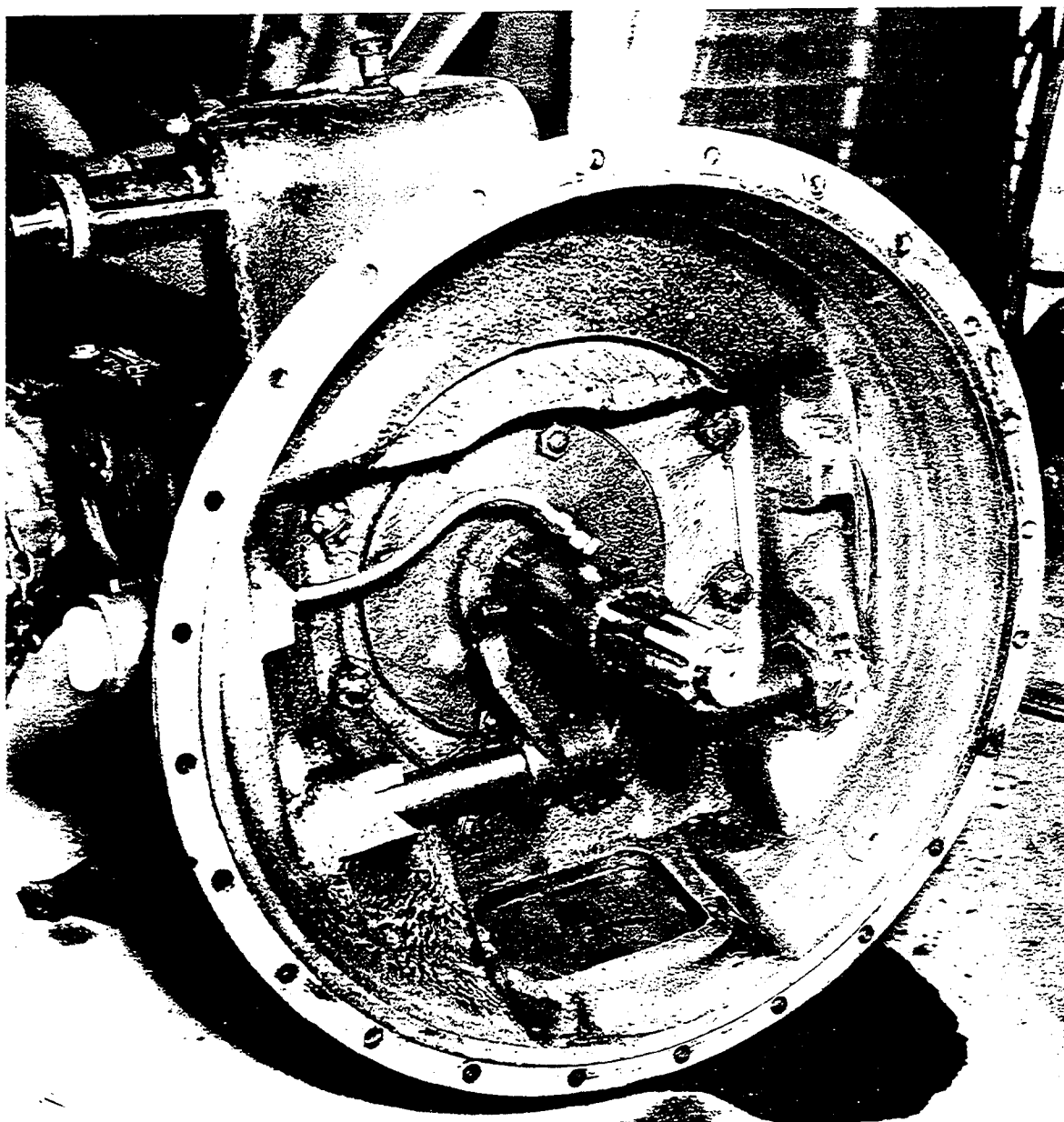
TESTING REBUILT D-2 GOVERNOR

Perform Operating and Leakage Tests as outlined in Service Checks section.

## CLUTCH AND CONTROLS

For operating procedures, maintenance and specifications, see Sec. 5 page 1 thru 14 of Maintenance Manual X-6114 for Model PD-4106.

Figures 2, 3 and 4 in the clutch section are not applicable to our installation.





# CLUTCH AND CONTROLS

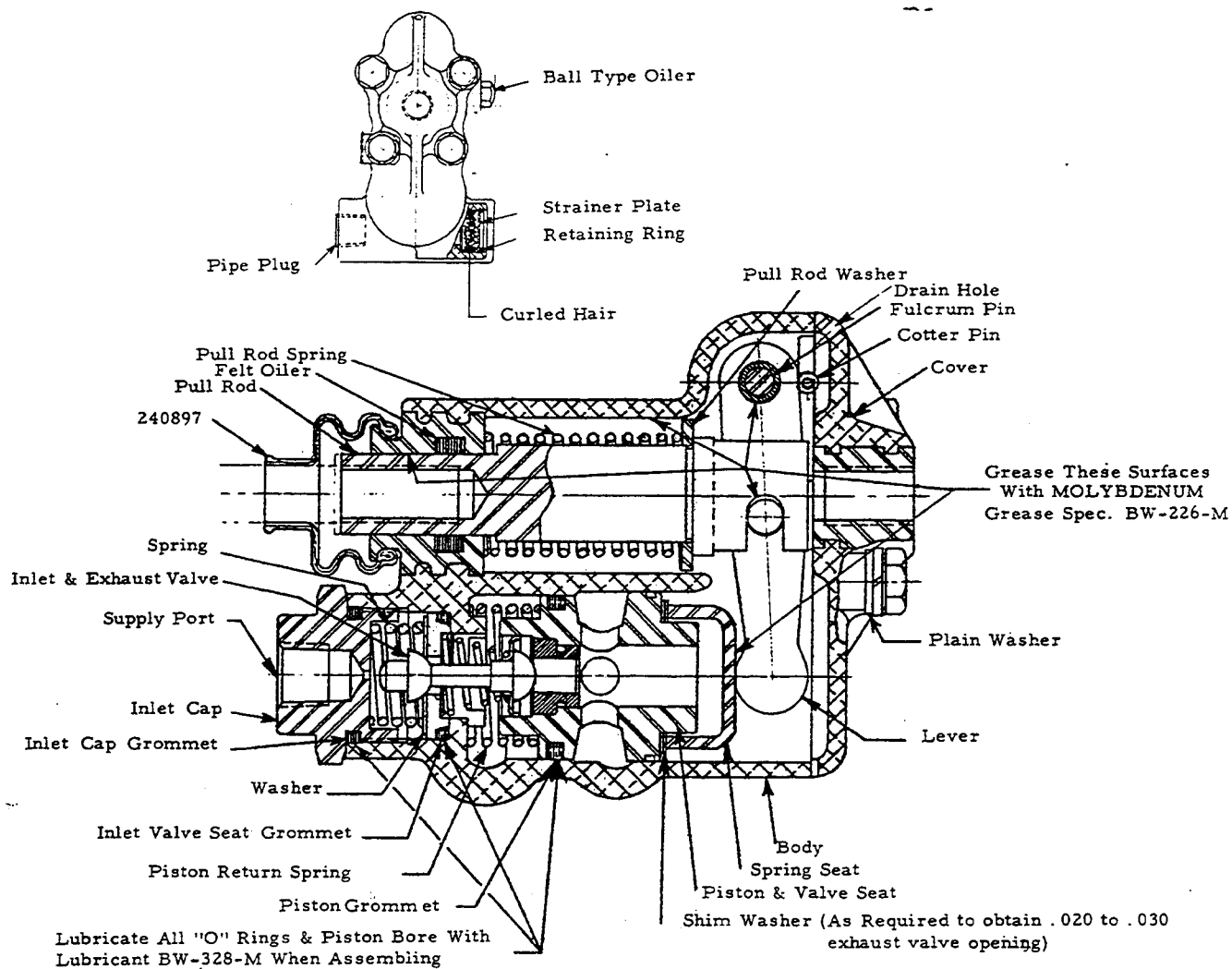


Fig. 3 Pull Type Valve

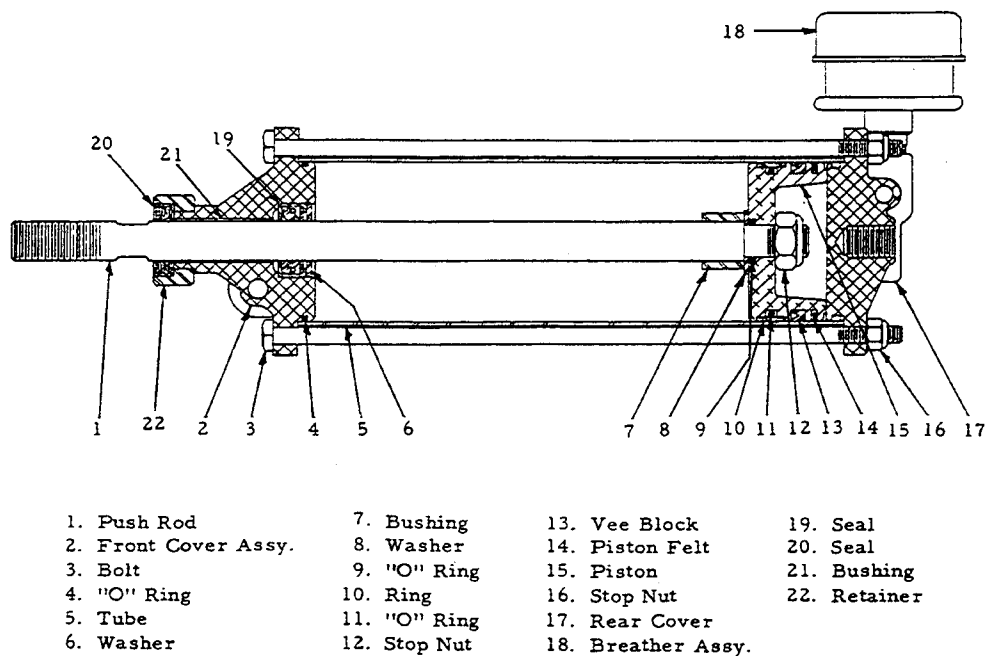
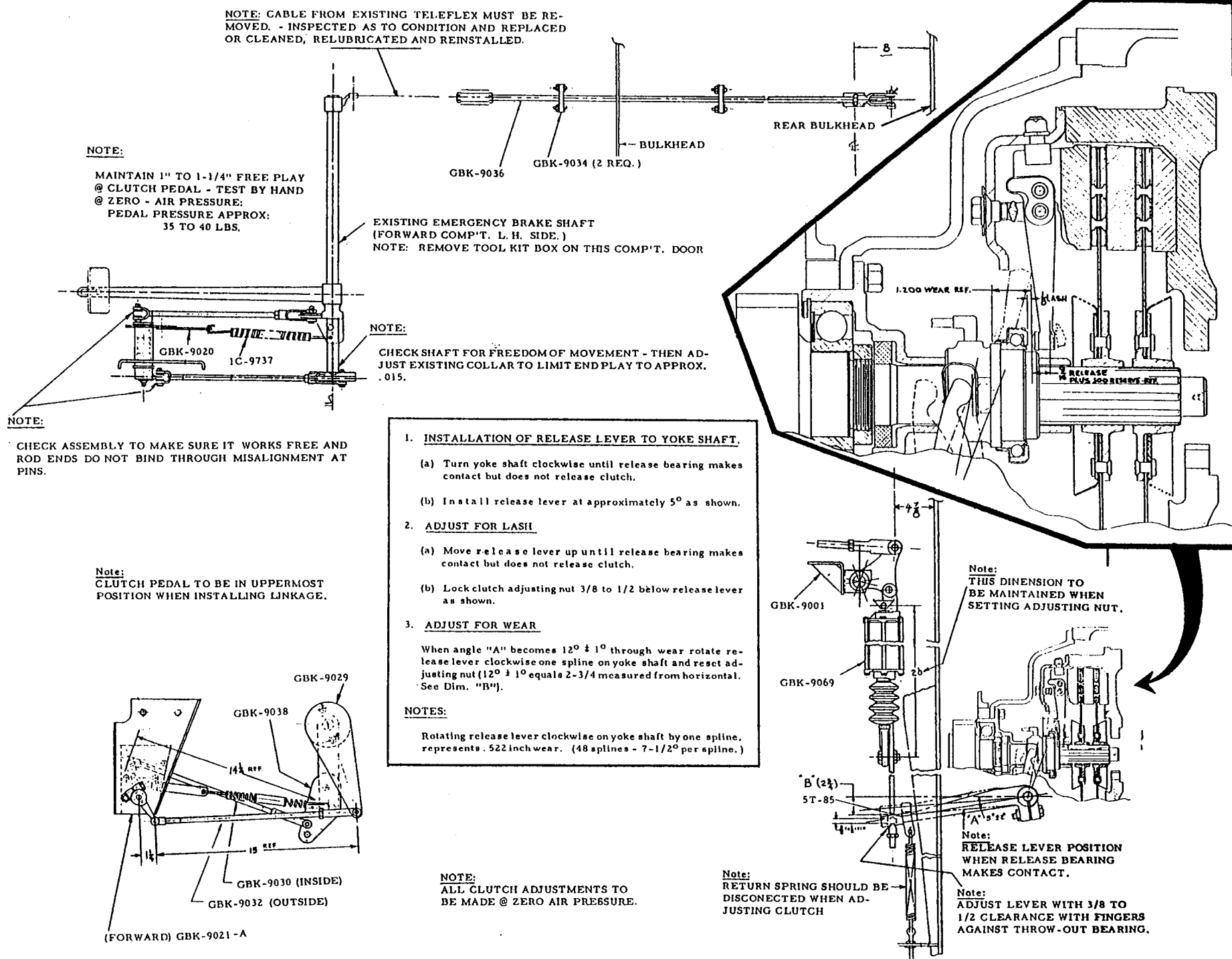


Fig. 4 Clutch Air Assist Cylinder



## COOLING SYSTEM

For operating procedures, maintenance and specifications, see Sec. 6 pages 1 thru 8 of Maintenance Manual X-6114 for Model PD-4106 except:

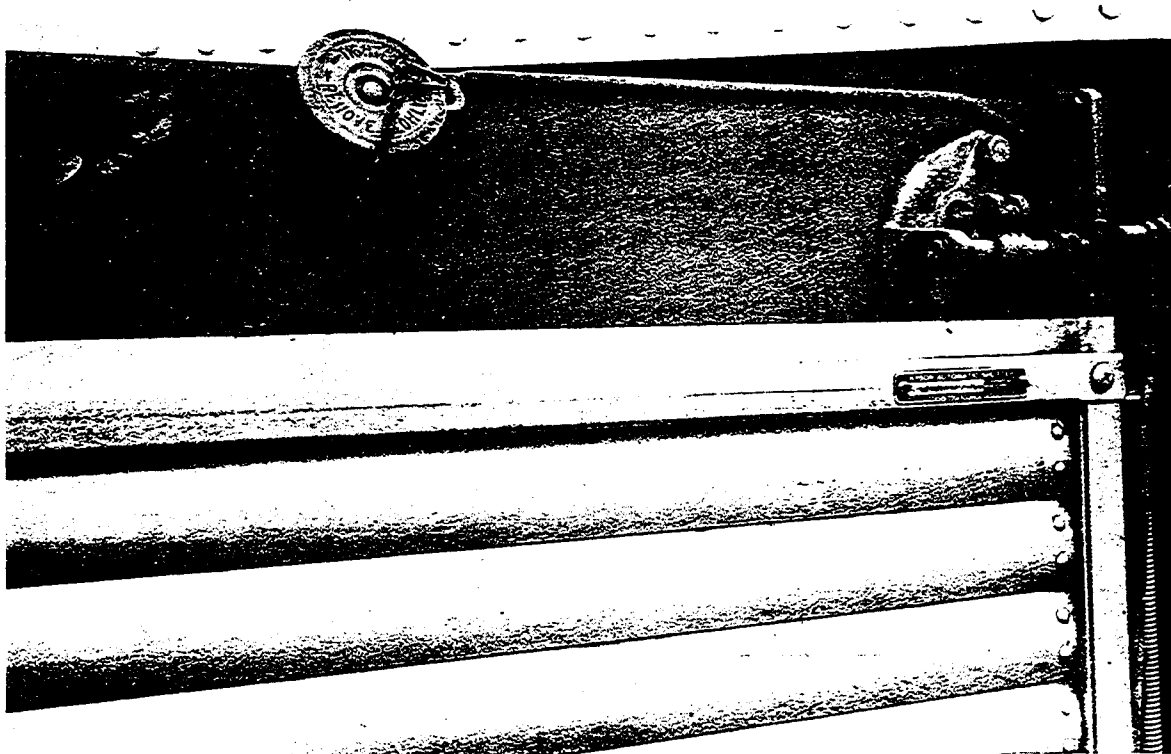
The surge tank is now part of the upper header tank of the rod on the repowered jobs and filling of the system is made into the radiator filler neck.

A radiator pressure relief valve cock is incorporated in design. Push prior to checking water level.

A fixed fan is used, belt driven from main engine.

The radiator shutters are operated by a Vernatherm control in the top tank of the radiator.

The water temperature overheat switch on the repowered units also de-energizes air fuel control solenoid and stops engine.



## COOLING SYSTEM

ADJUSTMENT AND MAINTENANCE FOR SHUTTERS  
WITH VERNATHERM CONTROL UNIT ASSEMBLY

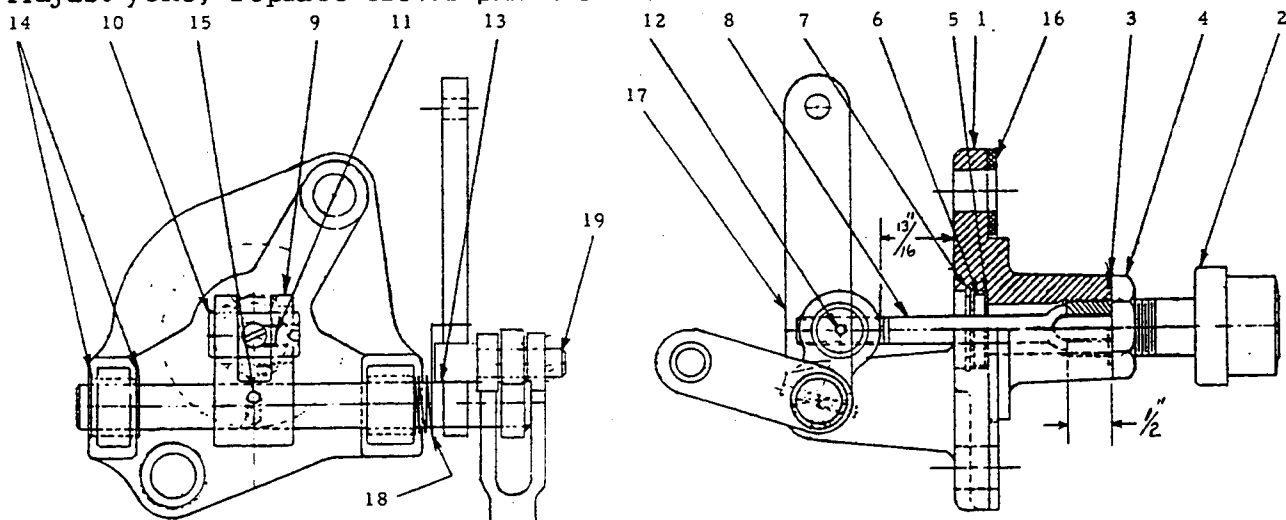
The vernatherm control unit assembly is not adjustable for various temperature settings. To operate the engine at higher or lower temperatures than those at which the vernatherm control unit is functioning, it is necessary to replace the vernatherm power unit.

## TO REPLACE VERNATHERM POWER UNIT

When replacing vernatherm power unit remove old unit and jam nut. Assemble jam nut to replacement vernatherm power unit. Thread jam nut  $1/2$ " on vernatherm stem. Install rubber gasket on vernatherm element; position against jam nut. Install vernatherm power unit in body casting maintaining  $1/2$ " dimension established by positioning of jam nut. Tighten jam nut for seal. Loosen set screw. With screw driver adjust push rod to maintain  $13/16$ " dimension.

## SHUTTER CONTROL ASSEMBLY ADJUSTMENT

1. Make adjustment with engine cold and shutter vanes firmly closed.
2. Remove clevis pin from yoke.
3. Loosen set screw located in lever and shaft assembly.
4. With hand, press actuating lever of lever and shaft assembly to its full "in" position. With screw driver adjust push rod to maintain  $13/16$ " dimension. Making sure push rod remains firmly against vernatherm push pin.
5. Adjust yoke, replace clevis pin to actuate lever.



- |                     |                   |                       |                         |                  |
|---------------------|-------------------|-----------------------|-------------------------|------------------|
| 1. Flange Casting   | 5. Washer         | 9. Crank Bearing Yoke | 13. Lever & Shaft Assy. | 17. Lever        |
| 2. Power Unit Assy. | 6. Felt Washer    | 10. Bearing Pin       | 14. Retaining Ring      | 18. Lever Spring |
| 3. Packing Ring     | 7. Retaining Ring | 11. Lead Plug         | 15. Rollpin             | 19. Lever Pin    |
| 4. Jam Nut          | 8. Push Rod       | 12. Set Screw         | 16. Flange Gasket       |                  |

Fig. 6

## COOLING SYSTEM

SUBJECT: RE-ROUTING OF HEATER LINES - PD-4501 CONVERSION

## REASON:

To provide additional water at heater core and eliminate excess controls.

## GENERAL:

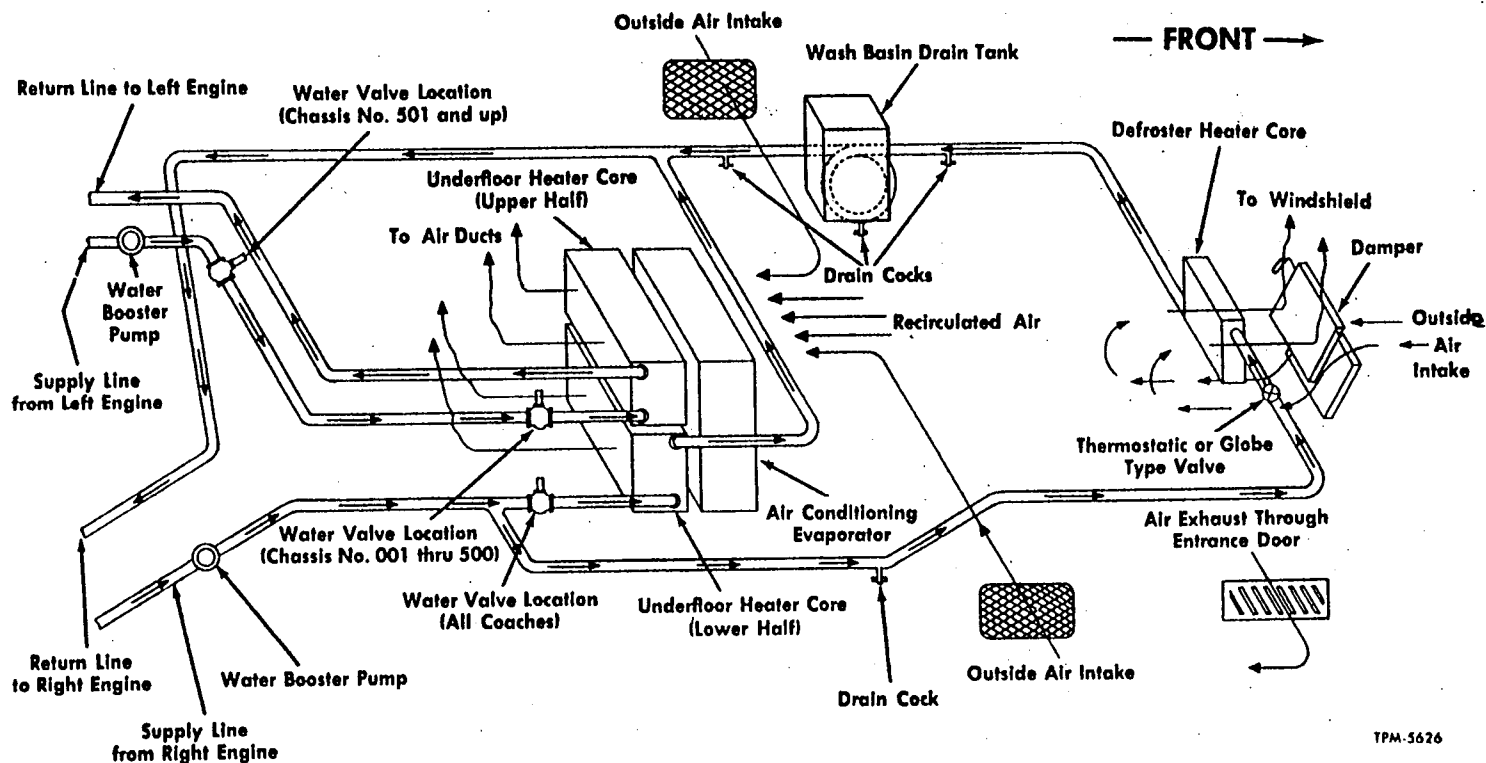
Continued testing on converted Scenicruiser coaches permits us to make the following additional improvements to the water system of the new single engine installation.

1. The left water booster pump can be removed.
2. Snubber type (air operated) Vapor valves can be eliminated entirely in favor of the modulating (electric) type.
3. One water control valve (Vapor) can be eliminated and the system can be controlled with the remaining valve.
4. Two relays are removed from circuits.
5. A separate switch to control coach thermostat is added.

## PROCEDURE:

1. Remove left booster water pump from engine bulkhead and return same to stock. Wire right pump in "Fast Idle" circuit.
2. Remove all snubber type Vapor valves, part #3553-1420, from coaches Serial No. 501 and up. One valve is located on the engine bulkhead and one is in the heater compartment. Substitute on #3545-3715 valve (See 3 below) for snubber valve removed in heater compartment. See illustration for proper installation.)
3. Coach Serial No. 1-500 had two Vapor valves #3545-3712 installed per factory. (See Maintenance Manual X-5822, Section 3B, Page 10.) Remove the upper valve and hook up a reworked heater core as illustrated. Removed valve should be saved for installation on a Serial 501 and up coach. (See 2 above) New heater cores are being purchased for the last 500 coaches to be reworked. GM&S will rework their stock of new cores as a bank prior to receipt of new cores.
4. Remove skinner solenoids to stock.
5. Add new watersupply line to booster pump from right side of engine as illustrated.
6. Plug water inlet and outlet of engine on left side.
7. Plug left water return line in plenum chamber as illustrated on the revised schematic diagram. This schematic replaces Figure 1 on Page 2 of Section 3B, Maintenance Manual X-5822.
8. Remove relays (See revised wiring diagram GBK-10550.)
9. Add nameplate #GPS-020470 as illustrated and hook-up switch to control operation of coach thermostat either "MANUALLY ON" which holds water valve in open position or "THERMOSTAT ON" in which position water valve will cycle to satisfy coach thermostat.

# EXISTING SCHEMATIC OF HEATER CIRCUIT

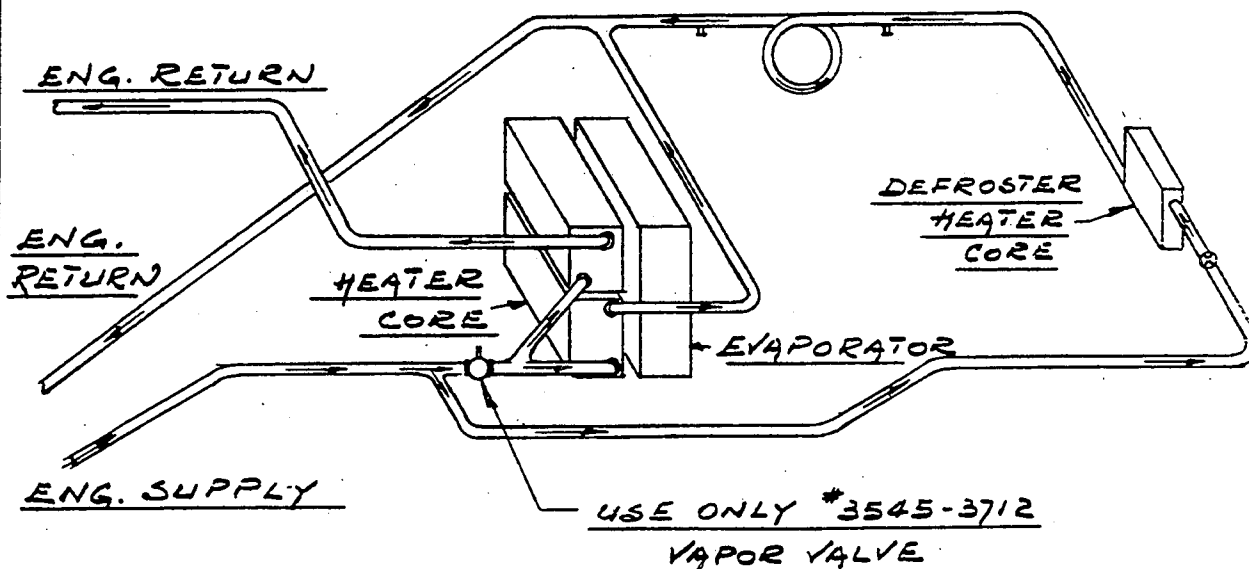


TPM-5626

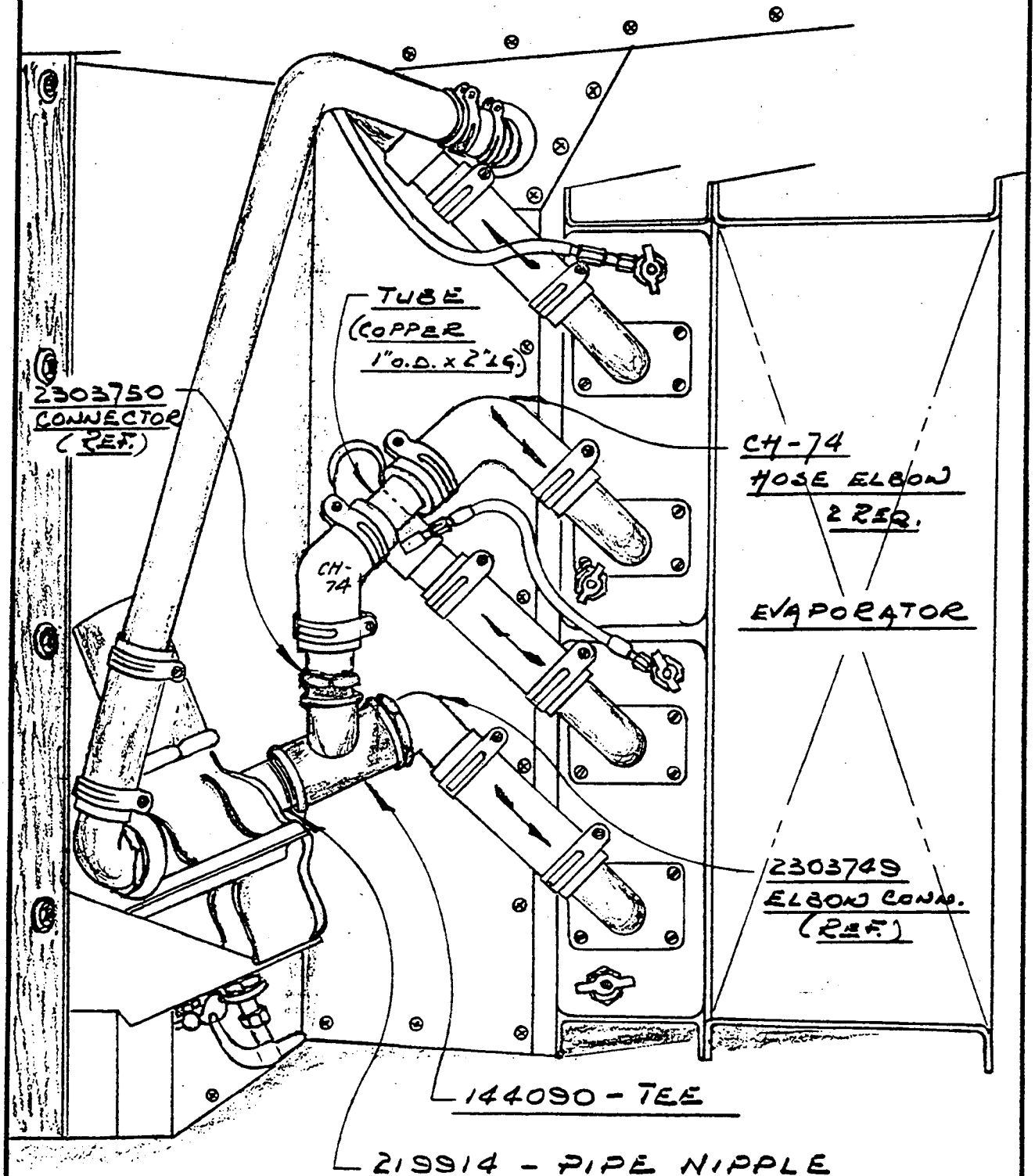
## COOLING SYSTEM

THE GREYHOUND CORPORATION

EQUIPMENT DEPARTMENT

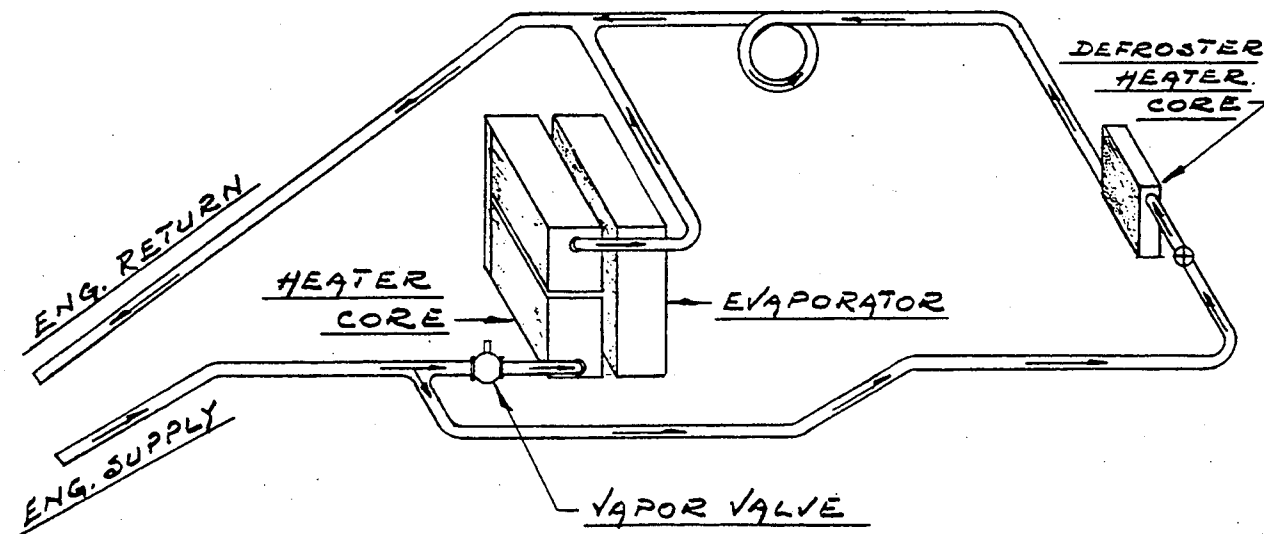
PROJECT NO. BUL. 2384 PAGE: 4BY: R. PAWLISZ DATE: 1-30-62REVISED SCHEMATICOF HEATER CIRCUITUNTIL NEW HEATER CORE AVAILABLE.MATERIAL REQ'DFOR EXISTING HEATER CORE219914 - PIPE NIPPLE (1" x 3" LG, BRASS)144090 - TEE (PIPE 1/2" x 1" FEMALE, BRASS)CH-74 - HOSE (1" I.D. ELBOW) 2 REQ.TUBE (COPPER 1" O.D. x 2" LG.)NOTE:REMOVE FROM SECOND VALVERE-USE:# 2303749 - ELBOW (CONNECTOR)# 2303750 - CONNECTOR (STRAIGHT)

PIPING ARRANGEMENT USING  
EXISTING HEATER CORE (\*2309866)





REVISED SCHEMATIC USING  
NEW HEATER CORE



NOTE:

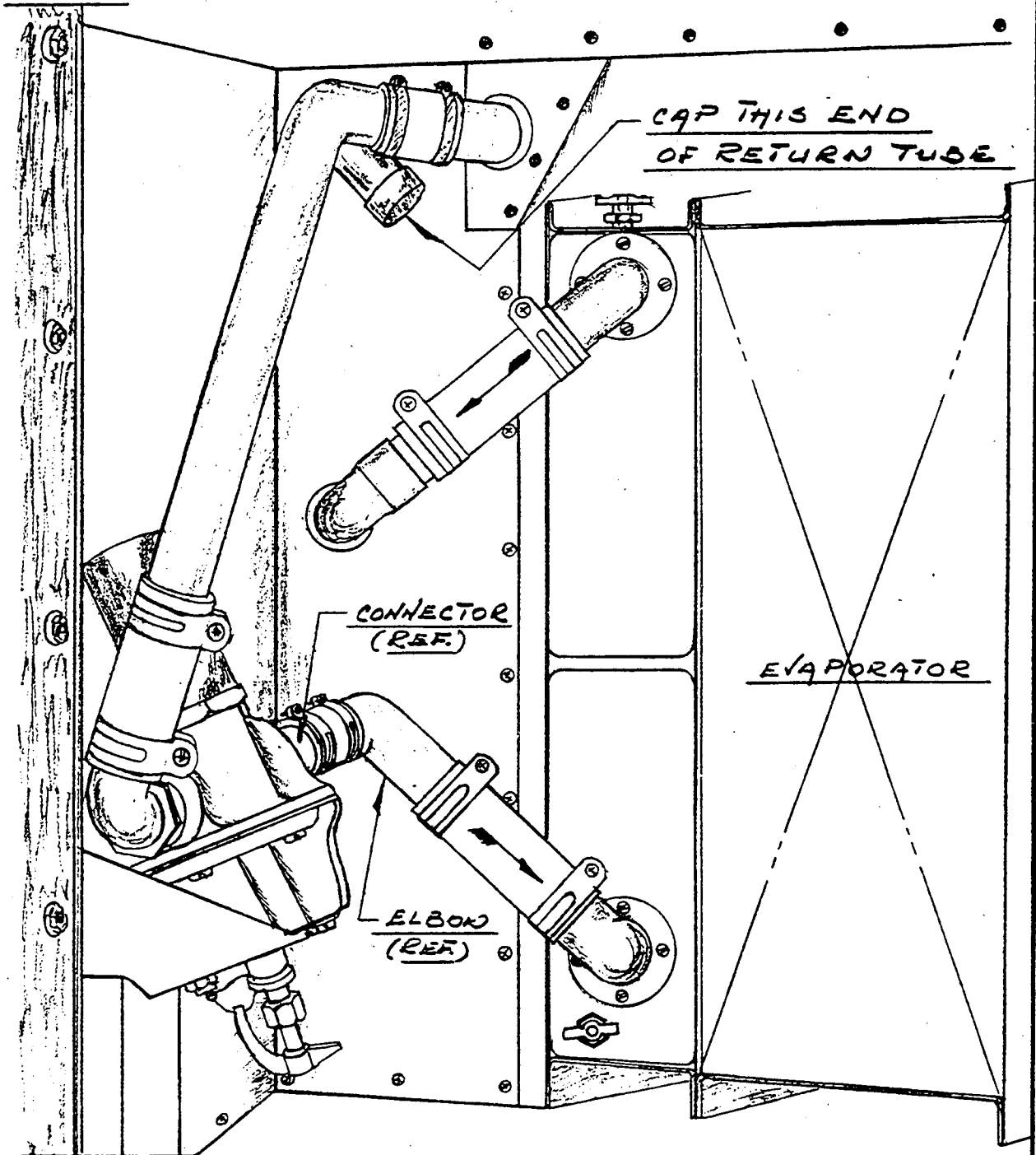
USE EXISTING FITTINGS

AS REFERENCED ON PAGE #7

COOLING SYSTEM  
THE GREYHOUND CORPORATION  
EQUIPMENT DEPARTMENT

PROJECT NO. BUL. 2304 PAGE: 7  
BY: R. PAULISZ DATE: 1-29-62

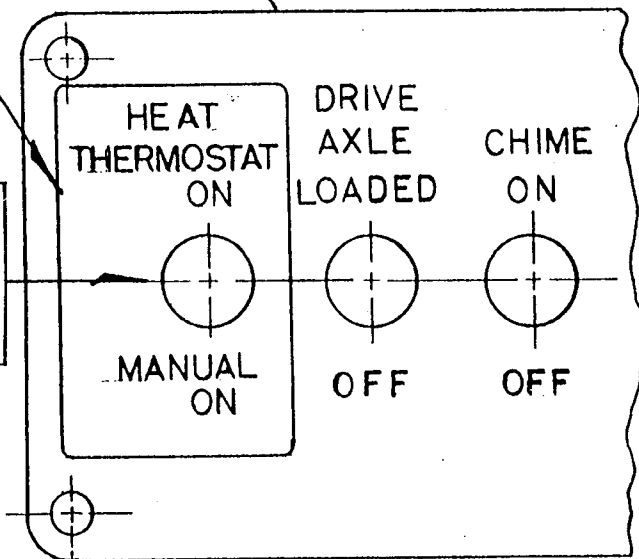
PIPING ARRANGEMENT USING  
REVISED HEATER CORE (GPS-020572)



DECAL LOCATION

SWITCH HOOK-UP

NAMEPLATE -  
DRIVERS PANEL  
(GY-3004) REF.



020570-DECAL  
THERMOSTAT  
BY-PASS  
SWITCH

USE EXISTING SWITCH  
AT THIS LOCATION  
NOTE: DECAL COVERS  
OLD LETTERING  
(UPPER DECK W/S FANS)

APPLY DECAL ON TO DRIVERS

PANEL PLATE AS SHOWN ABOVE

# REVISED HEATING SYSTEM WIRING DIAGRAM

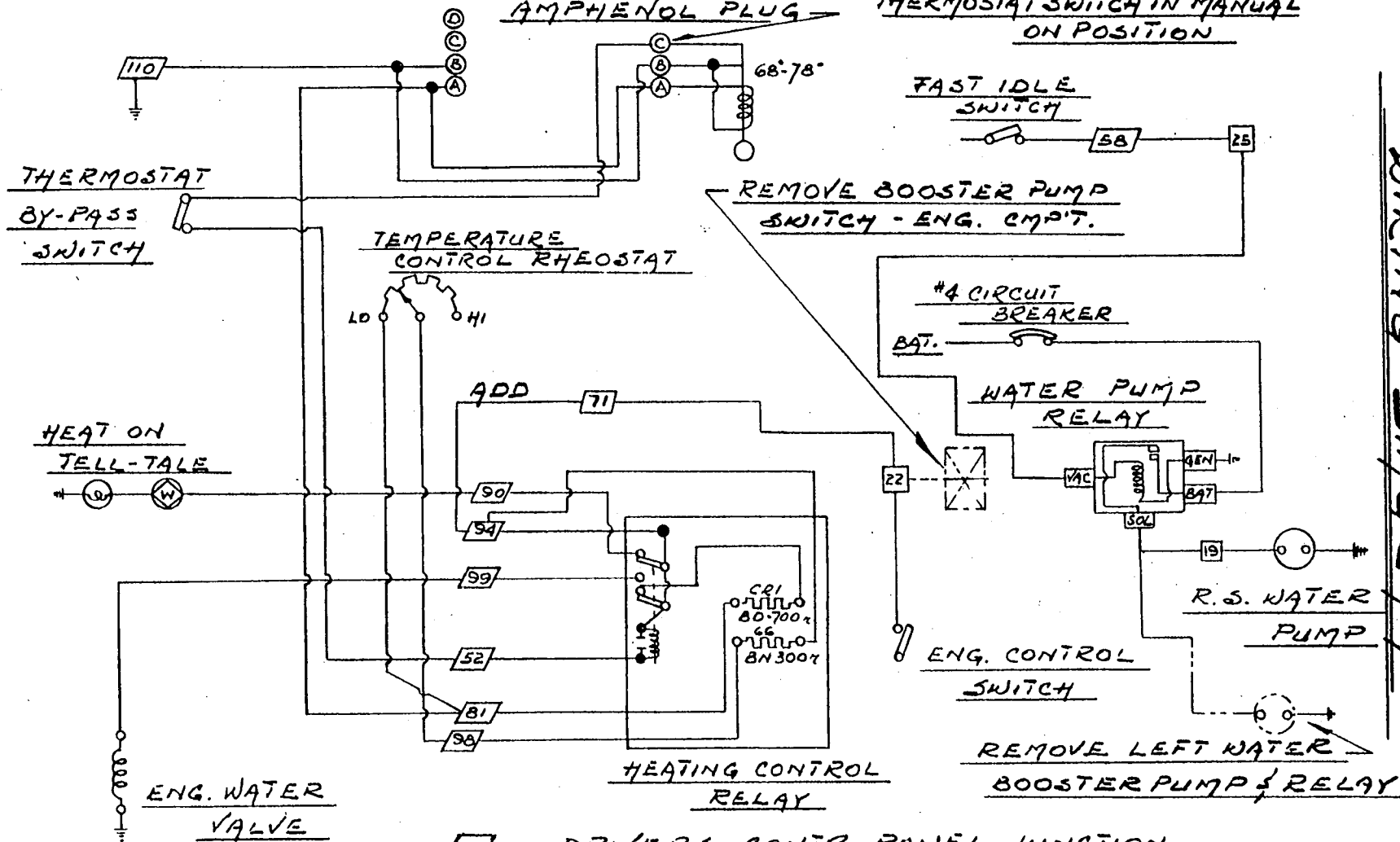
NOTE: TO PURGE WATER SYSTEM BOTH "FAST IDLE"

& THERMOSTAT BY-PASS SWITCHES

MUST BE "ON"

THERMOSTAT SWITCH IN MANUAL  
ON POSITION

HEATING THERMOSTAT  
AMPHENOL PLUG



- — DRIVERS CONTR. PANEL JUNCTION
- ◇ — LEFT SIDE SWITCH PANEL AMPHENOL PLUG
- — ENG. COMP'T CONTR. BOX JUNCTION

REF. MD-82610

COOLING SYSTEM

THE GREYHOUND CORPORATION

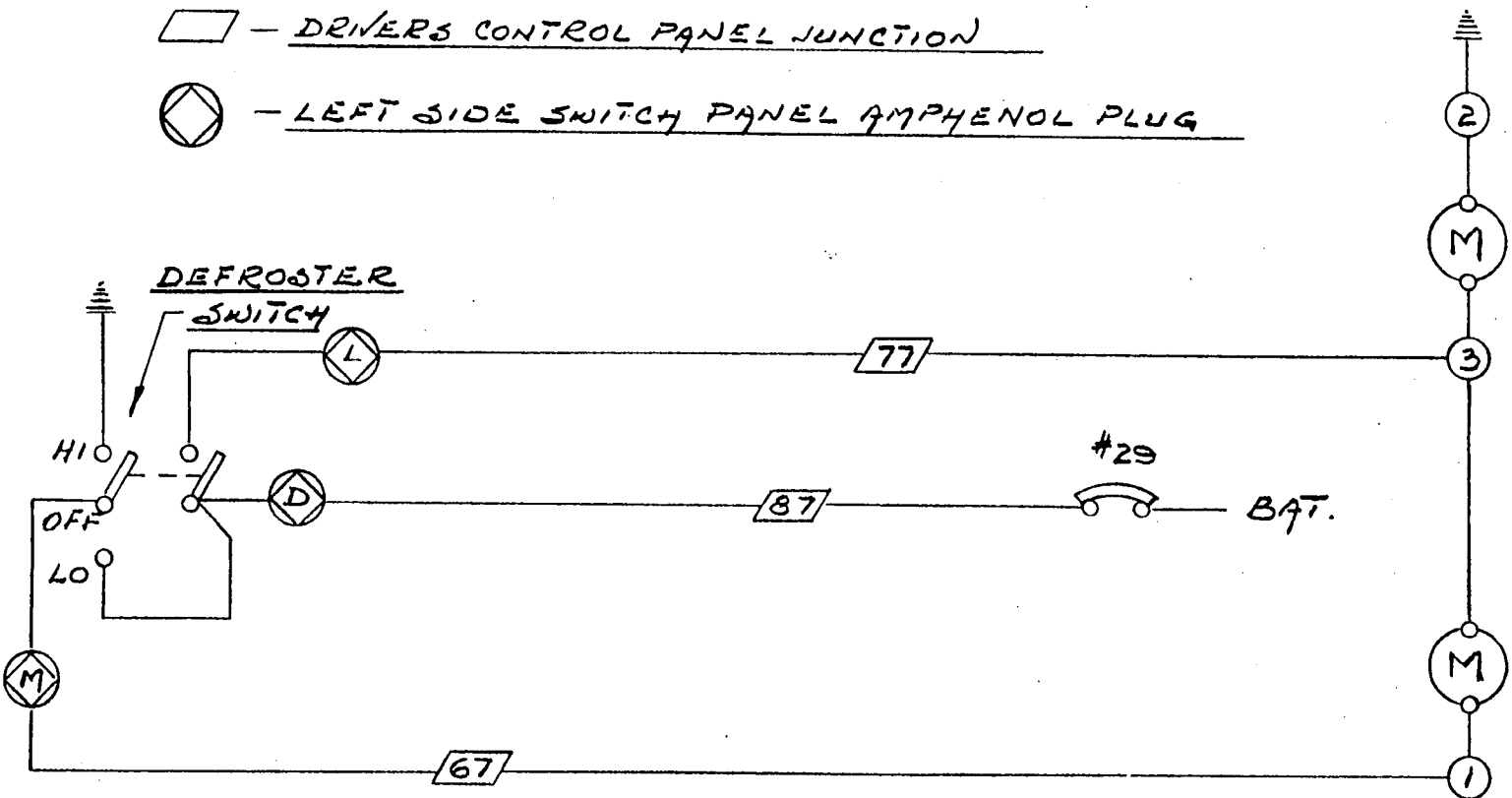
EQUIPMENT DEPARTMENT

PROJECT NO. BU. 2384 PAGE 10

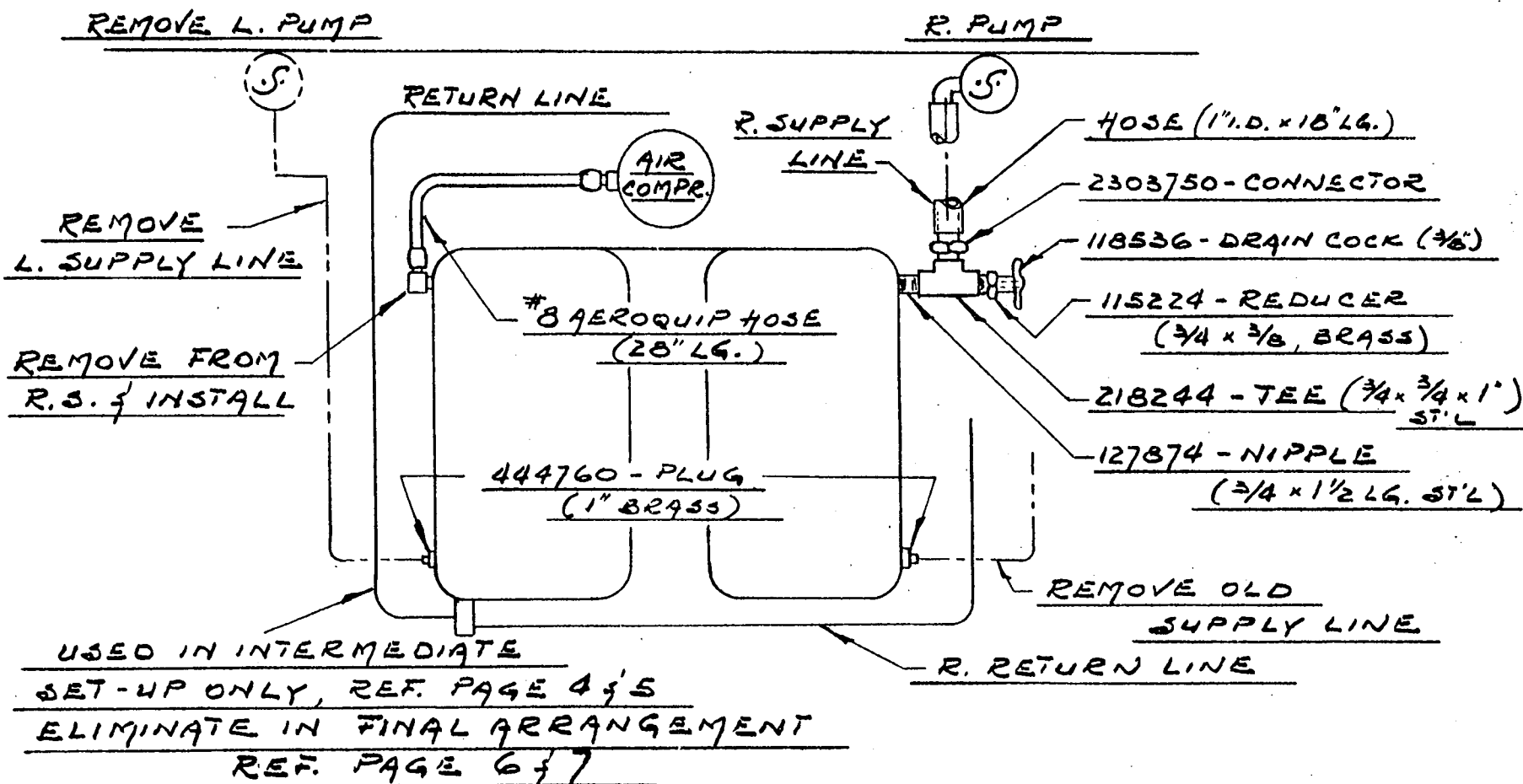
BY R. F. WILSON DATE 1-30-62

# REVISED DEFROSTER

## WIRING DIAGRAM



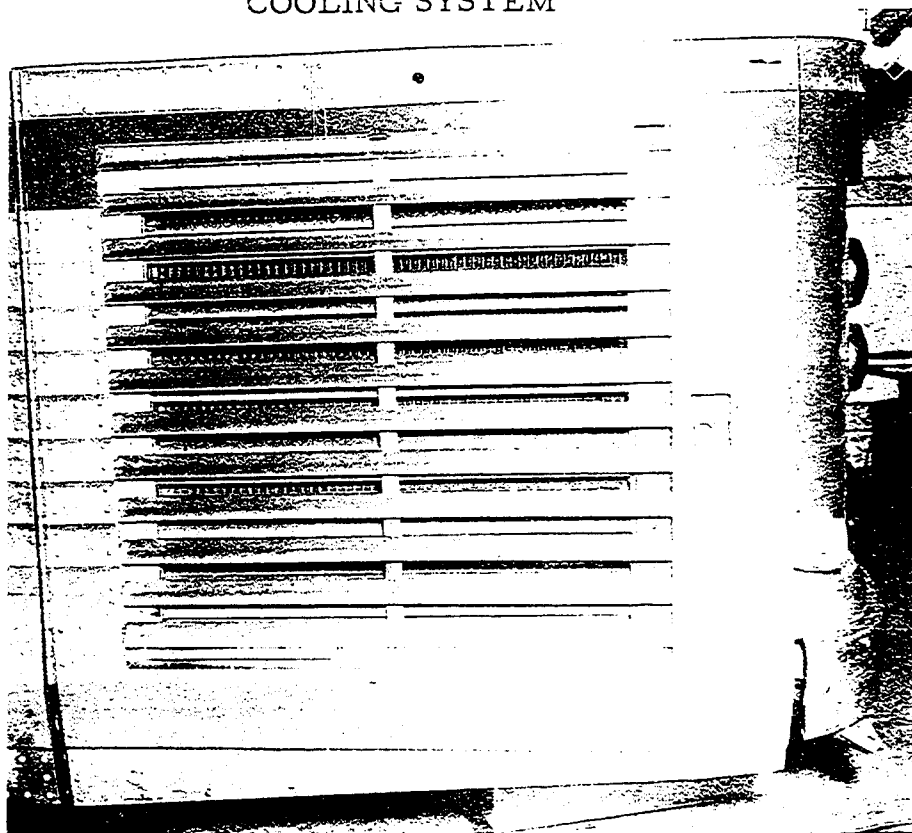
REF. MD-82608

ENGINE COMP'T REWORKNOTE:

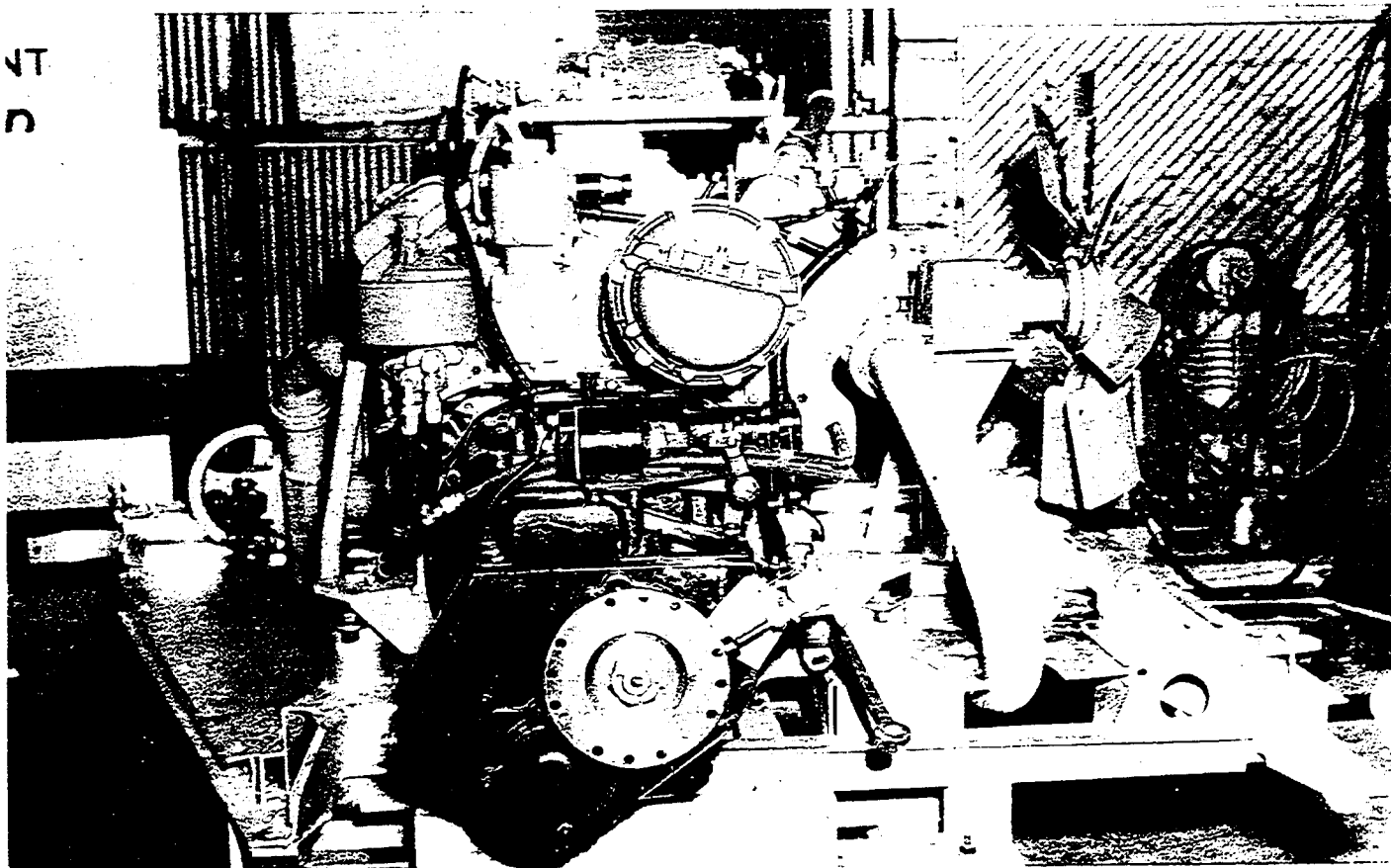
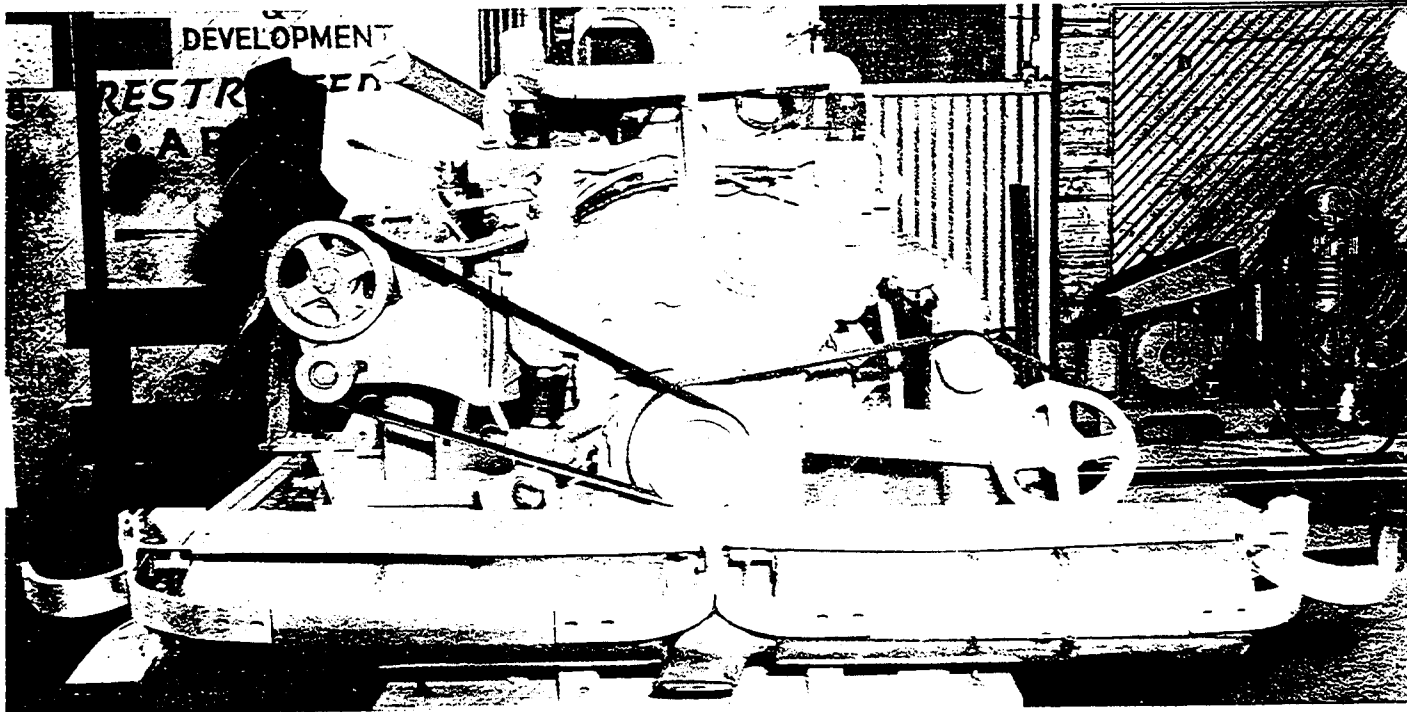
020573 - KIT CONTAINS NECESSARY MAT'L FOR ENGINE COMP'T REWORK

020574 - KIT HEATER COMP'T REWORK (REF. PAGE 4)

# COOLING SYSTEM

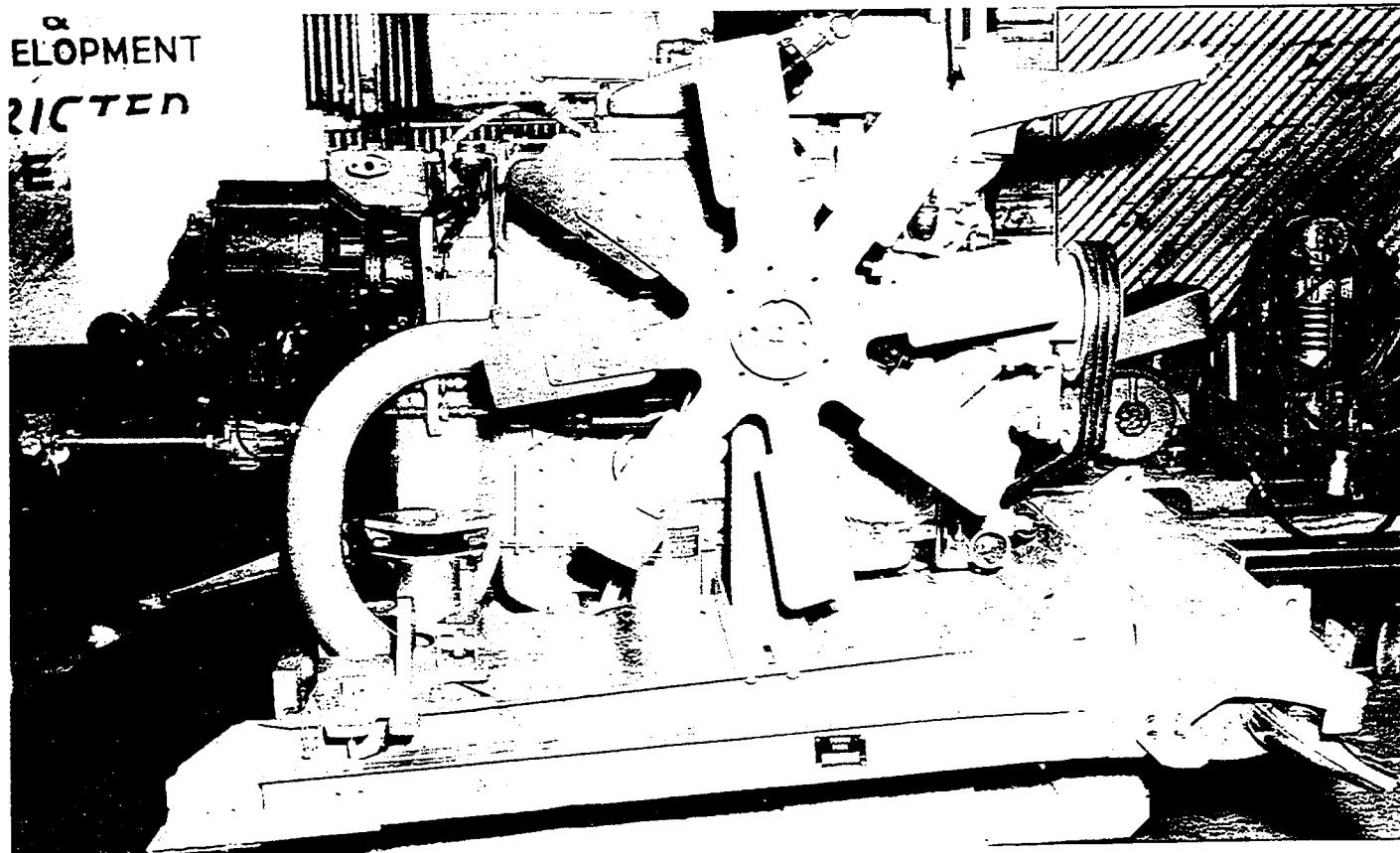


COOLING SYSTEM





COOLING SYSTEM



WIRING AND MISC. ELEC.

For information not listed herein, refer to Maintenance Manual X-5822 for Model PD-4501

Sec. 7A Page 1

Information is applicable except following diagrams are not used after repowering kit is installed:

77917	Generator and Regulator Circuit
79301	Emergency Stop Control
79302	2 Speed Clutch and Governor Control
79303	Starter Control
79484	Clutch Solenoid Valve Control
82607	Engine Control, Alarm and Signal
82609	Auxiliary Alarm System
TPM-5710	Schematic Wiring Diagram

Sec. 7A Page 2

Information is applicable except replace first paragraph only under heading "Gauge Panels" as follows:

Two gauge panels (Instrument Clusters) are mounted directly in front of driver, one on either side of steering column. All gauges except the air pressure gauge are operated electrically.

In the installation of a single V-8 engine, replacing the dual engine power unit, only one oil gauge and one temperature gauge is required; hence the oil pressure gauge in the left hand panel and the water temperature gauge in the right hand gauge panel are operative, the remaining two gauges are removed and plugs close off openings.

Sec. 7A Page 3

Information is applicable except items 10 and 14 of illustration are inoperative and a reverse shift switch has been installed in blank of panel directly under starter switch (1).

Sec. 7A Page 4

Information is applicable except reverse shift switch has been installed between switches (8) and (9) of figure 2.

## WIRING AND MISC. ELEC.

For information not listed herein, refer to Maintenance Manual X-5822 for Model PD-4501

## Sec. 7A Page 5

Information is applicable except delete last line of first paragraph which reads "Trans. Oil etc. " and items seven (7) and fourteen (14) of figure 5 is not used.

## Sec. 7A Page 6

Information is applicable except terminal seventeen (17) should read - No. 6 circuit breaker to generator exciter (diode).

## Sec. 7A Page 7

Information is applicable except:

<u>Term No.</u>	<u>Circuit</u>
52	Add "Thru Thermostat By-Pass Switch"
66	1st Line "From Clutch Pedal Micro-Switch" - Not used.
67	Remove "To defroster Booster Pump Relay"
71	Add "To driver's control panel Junction 94"
77	Remove "To defroster booster pump relay"
95	Open
103	Remove "To defroster booster pump relay"

## Sec. 7A Page 8

Information is applicable except:

<u>Term No.</u>	<u>Circuit</u>
73	2nd line "To Transmission Low Oil Tell Tale" - Not used.
78	1st line "From Transmission Low Oil Tell Tale" - Not used.
86	Not used.
92	Not used.

## Sec. 7A Page 10

Information is applicable except next to last paragraph should read: "R. H. START" switch is a double-pole, double-throw switch with center off, fixed on, and momentary on positions. Switch will remain in fixed on and off positions and must be held in momentary on position.

WIRING AND MISC. ELEC.

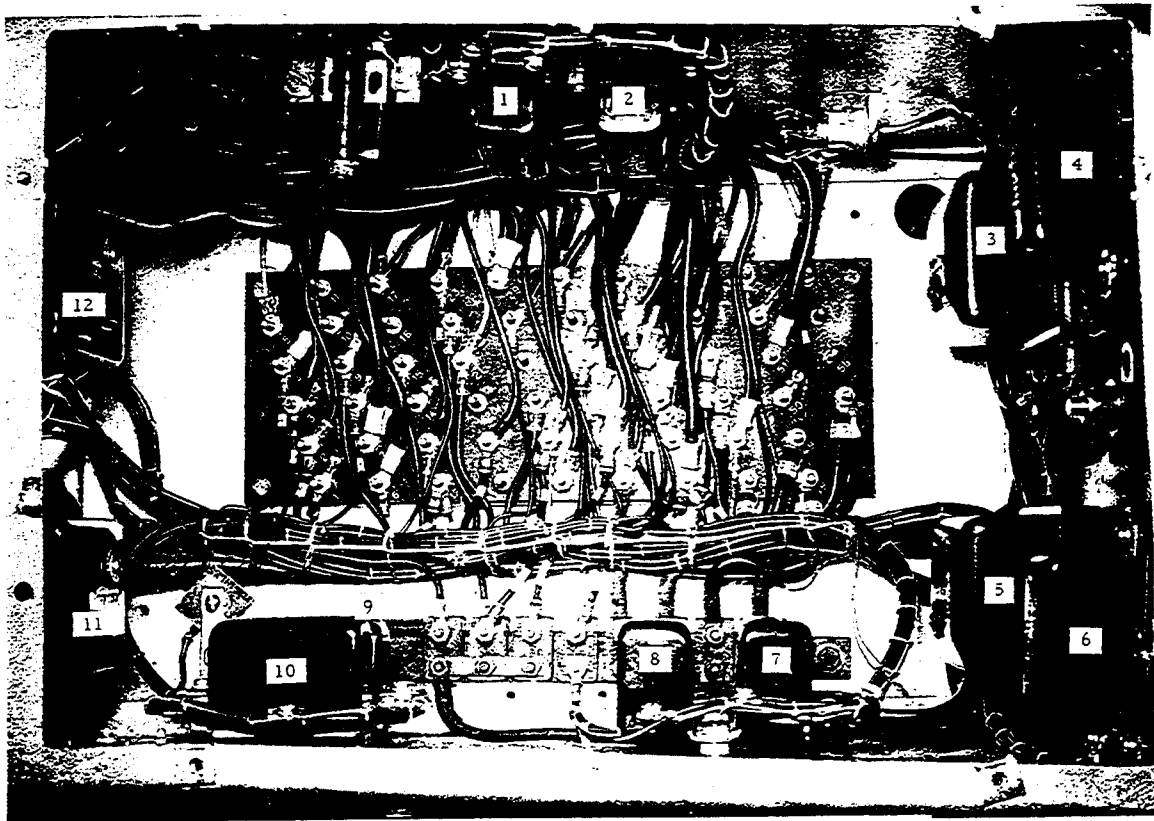
For information not listed herein, refer to Maintenance Manual X-5822 for Model PD-4501

Sec. 7A Page 11

Information is applicable except:

Figure 7 Relay (4) - Not used.  
Figure 7 Relay (8) - Not used.  
Figure 7 Switch (12) - Not used.  
Figure 7 Switch (13) - Not used.  
Figure 7 Switch (15) - Not used.  
Figure 7 Switch (16) - Not used.  
Figure 7 Rectifier (19) - Not used  
Figure 7 Rectifier (20) - Not used  
Figure 7 Relay (23) - Not used

ENGINE COMPARTMENT CONTROL BOX



- |                               |                          |
|-------------------------------|--------------------------|
| 1. 852 Field                  | 7. 852 Water Pump        |
| 2. 797 Gen. , Speedo. & Pilot | 8. 852 Low Oil           |
| 3. 899 Interior Lights        | 9. 852 Alarmstat         |
| 4. 805 Engine Shut Down       | 10. 852 Hot Engine       |
| 5. 899 Reading Lights         | 11. 899 Air Conditioning |
| 6. 852 Reverse Shift          | 12. 810 Starter          |

## WIRING AND MISC. ELEC.

For information not listed herein, refer to Maintenance Manual X-5822 for Model PD-4501

Sec. 7A Page 12

Information is applicable except:

<u>Term No.</u>	<u>Circuit</u>
1	From drivers control panel Jct. #50 to Reverse solenoid relay coil.
2	From engine cut out relay to engine amphenol #2 post P to engine stop solenoid
4	From reverse solenoid relay to #2 engine amphenol #2 post B to reverse solenoid
5	Remove "RH" from second line
6	From post #4 starter generator relay to engine #1 amphenol G to generator relay terminal post
7	From voltage regulator (FIELD) to engine #1 amphenol F to generator field terminal post
8	Remove "From engine amphenols J&K" Add "To engine immerson thermostat relay"
9	Not used
11	Not used
14	Remove "To R. S. water pump relay"
15	Not used
16	Remove "RH" from second line
17	Not used
18	Not used
19	From water booster pump relay To water booster pump
20	Remove "To booster pump switch"
21	Not used
22	From engine control switch To driver's control panel Junction 71
23	Not used
25	Add "To water pump relay"
26	Not used
27	Remove "From water booster pump switch"

Sec. 7A Page 13

Information is applicable except:

<u>Term No.</u>	<u>Circuit</u>
29	Regulator negative to engine #2 amphenol C to generator field terminal unmarked from generator diode to resistor from field relay.

## WIRING AND MISC. ELEC.

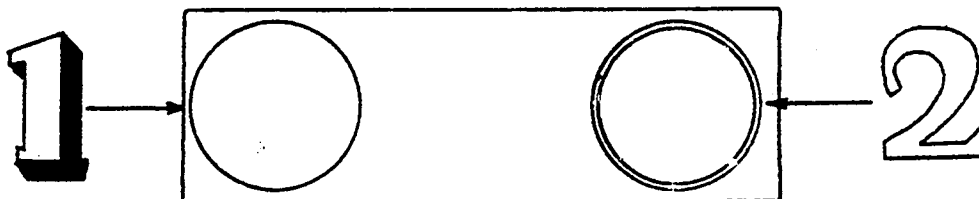
For information not listed herein, refer to Maintenance Manual X-5822 for Model PD-4501

Sec. 7A Page 13  
(continued)

<u>Term No.</u>	<u>Circuit</u>
31	Last line remove "No. 1" from description
33	From starter generator relay post #5 to generator field relay coil to generator arm relay to terminal post #31 to engine cut out relay
35	Not used
37	Bus Bar to 36 (Ground)
38	Not used
47	Not used
50	Not used
55	Not used

Sec. 7A Page 18

Information is applicable except delete "No. 1 Engine Amphenol" and add:



Plug #1

<u>Term Letter</u>	<u>Circuit</u>	<u>Wire Size</u>
A	Speedometer Sending Unit A to Terminal Block #2	#14
B	Speedometer Sending Unit B to Terminal Block #1	#14
C	Speedometer Sending Unit C to terminal Block #4	#14
D	Speedometer Sending Unit D to Terminal Block #3	#14
E	Speedometer Sending Feed to Post #31	#14
F	Alternator Field to Regulator through Post #7	#10

## WIRING AND MISC. ELEC.

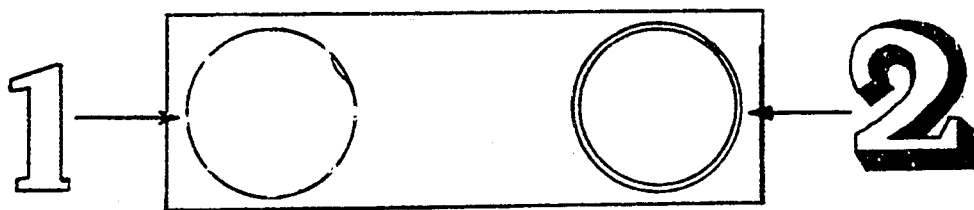
For information not listed herein, refer to Maintenance Manual X-5822 for Model PD-4501

Sec. 7A Page 18  
(continued)

<u>Term Letter</u>	<u>Circuit</u>	<u>Wire Size</u>
G	To Alternator Relay Post through Post #6	#10
H	Spare to Engine Amphenol	#14

Sec. 7A Page 19

Information is applicable except delete "No. 2 Engine Amphenol" and Add:



Plug #2

<u>Term Letter</u>	<u>Circuit</u>	<u>Wire Size</u>
A	Solenoid & Speedometer Sending Unit	
	Ground to Post #36	#14
B	To Reverse Solenoid Relay through Post #4	#10
C	Alternator Post unmarked to Post #29	#10
D	Emergency Stop Solenoid through Post #51	#12
E	Starter Solenoid through Post #38	#10
F	Empty	#14
G	Water Temperature Gauge Sending Unit	
	through Post #24	#14
H	Empty	#14
J	Moto-guard Sending Unit through Post #8	#14
K	Empty	#14
L	Fast Idle Solenoid through Post #25	#14
M	Not used	#14
N	Not used	#14
P	Engine Stop Solenoid through Post #2	#14
New	Oil Pressure Gauge to Post #16	
New	Low Oil Pressure Switch to Post #3	
New	Reverse Solenoid Relay Coil fed through Post #1	

WIRING AND MISC. ELEC.

For information not listed herein, refer to Maintenance Manual X-5822 for Model PD-4501

Sec. 7A Page 21

Information is applicable except:

Remove second paragraph "Overdrive Switch Junction Block" in its entirety.

Add the following paragraph prior to paragraph "1" at bottom of page:

1. The negative cable leads to battery disconnect switch; located on original regulator box and then to engine compartment control box main battery stud. Cable is accessible through battery door on right-hand rear side of vehicle.

Sec. 7A Page 24

Information is applicable except:

Change Paragraph 9 to : "LOW OIL. " This tell-tale is interconnected with engine low-oil pressure switch, with engine alarm buzzer, and with engine cut-out relay. Tell-tale and buzzer indicate that oil pressure in the engine is below 3 psi. Low oil condition will cause the engine cut-out relay to stop engine.

Change Paragraph 10 to: "HOT ENG. " This tell-tale is interconnected with engine alarmstat switch, with engine alarm buzzer and with engine cut-out relay. Tell-tale and buzzer indicate that temperature of the engine is too high for safe operation. Overheated condition will cause the engine cut-out relay to stop engine.

Delete Paragraph 11 in its entirety.

Sec. 7A Page 28

Information is applicable except:

Delete paragraph entitled "Transmission Low Oil Pressure Switch" and figure 22. This component is not used.

Sec. 7A Page 30

Information is applicable except:

Change "Engine Cutout Relay" to read as follows:

Engine cutout relay is mounted in engine compartment control box. Cutout relay is interconnected with engine Alarmstat signal relay and engine low oil alarm signal relay. Circuit to engine stop solenoid valve, which must be energized with engine



## WIRING AND MISC. ELEC.

For information not listed herein, refer to Maintenance Manual X-5822 for Model PD-4501

Sec. 7A Page 30  
(continued)

running, is through the normally closed contacts of the engine cutout relay. Cutout relay operating coil circuit is fed from the generator armature and is grounded when contacts of either alarm signal relays are closed by low oil pressure or overheated engine. Thus, with engine running, if either of the alarm signal relay contacts are closed by an abnormal condition, the cutout relay operating coil circuit is energized. With operating coil energized, cutout relay contacts open, breaking the circuit to the engine stop solenoid valve. With solenoid valve de-energized, air pressure is admitted to the injector rack air cylinder on engine, moving the injector racks to no-fuel position and stopping the engine.

When "LOW OIL" or "HOT ENG." tell-tale illuminates and buzzer sounds, the engine stops. Under no condition should engine be run after point of safety is reached, or restarted until abnormal condition is corrected.

Change "Cutout Relay System Test" to read as follows:

Start engine and run until air pressure is built up.

Open both the left rear side door to engine compartment and the rear engine access door.

Remove Douglass connector from alarmostat while engine is running and connect to test terminal. Engine should stop immediately.

Restart engine and short across low oil switch terminals (located on engine oil pressure manifold on rear bulkhead). Engine should stop.

If, when either the engine alarmostat lead or low oil pressure lead is grounded, the engine fails to stop, it indicates either a defective cutout relay, generator not charging, or defective wiring.

Sec. 7A Page 31

Information is applicable except:

Delete two partial paragraphs at top of page.

Change relay list as follows:

Delete

Engine Cutout Relay (Thermal Type). . . Engine Comp't Control Box (Fig. 7)...  
Refer to Page 30".

For information not listed herein, refer to Maintenance Manual X-5822 for Model PD-4501

Sec. 7A Page 31  
(continued)

Add

Engine Cutout Relay. . . . Engine Comp't Control Box . . . 1116805

Sec. 7A Page 34

Information is applicable except:

Delete "Governor Relay" in its entirety.

Sec. 7A Page 35

Information is applicable except:

Delete paragraphs entitled "Engine Cutout Overrule Relay" and "Engine Starter Relays" and add the following:

Generator Field Relay

Generator field relay is mounted in the engine compartment control box and is energized only when generator is charging, and the field has been initially energized through the generator diode unit and the engine has been brought to a speed of approximately 700 R. P. M.

Relay "Bat. " terminal is fed from post #6 on the starter generator relay.

"Sol. " post on relay connects to post #29 in engine compartment control box junction panel.

"Gen. " terminal connects to post #33 in engine compartment control box junction panel.

"Vac. " terminal connects to ground.

Sec. 7A Page 39

Information is applicable except:

Add the following:

Relay #1116805

This relay is used as the engine cutout relay and is mounted in the engine compartment control junction box.

## WIRING MISC. AND ELEC.

or information not listed herein, refer to Maintenance Manual X-5822 for Model PD-4501

Sec. 7A Page 39  
(continued)

The contacts of this relay are normally closed and are connected between the rear run switch and post #2 in the engine compartment control junction box.

One end of the coil is fed from post #33 engine compartment control junction box while the other end is connected to post #12 in the engine compartment control junction box.

When the engine is running, and the generator is charging, both the engine alarmostat signal relay and the low oil signal relay contacts are closed, completing the circuit to both the engine alarmostat and the engine low oil pressure switch. When either of these units, by reason of the engine being overheated or through the loss of oil pressure, completes the circuit to ground, the coil of the relay is energized and breaks the normally closed contacts causing the engine stop solenoid to become de-energized and the engine stops.

## ADJUSTMENTS

Air gap armature down .030

Opening voltage 8 to 10

Make air gap adjustment by bending armature stop.

To check opening voltage, connect a variable resistor and voltmeter to one coil end, ground one voltmeter terminal and the other coil end, vary resistance when the resistor fed from the battery to determine point opening voltage.

Relay #1115810

Starter control and generator relay is mounted in electrical compartment junction box. Electrical circuits and connections are shown on "Engine Control and Generator Wiring Diagram." Relay circuits are also illustrated on "Generator System Schematic Wiring Diagram" in "GENERATOR" Section. This is a two-unit relay, with the two units interlocked in such a manner that the starter cannot be engaged when the generator is charging.

The smaller of the two units serves as a starter control relay and the actuating current is supplied through the starter switch; this circuit is routed to ground through the upper contacts of the generator control relay, which are closed only when the generator is not charging. Battery current is supplied to the lower contacts of both relays through terminal number 6. When starter switch is energized and lower points close, battery current then flows through the lower points and number 2 terminal to the starter solenoid, operating the starter. When the engine starts and starter switch is opened, the operating coil of the starter relay is de-energized and the lower points open, breaking the circuit to the starter solenoid.

For information not listed herein, refer to Maintenance Manual X-5822 for Model PD-4501

Sec. 7A Page 39  
(continued)

Relay #1115810 (continued)

The operating circuit of the generator relay (large unit) is fed from the "RELAY" terminal on the generator. When generator is charging, operating coil is energized. With the generator relay operating coil energized, the lower contacts close. Battery current then flows through the lower contacts and number 5 engine panel junction 33. No-charge tell-tale light is connected to generator relay.

RELAY ADJUSTMENTS

Refer to "Specifications" at end of this section for air gap and point opening dimensions and for closing voltage values.

Air Gap

Disconnect battery wire from number 6 terminal, then remove relay cover. Check and adjust each unit as follows:

Sec. 7A Page 39A

1. Small Unit. Press armature down until lower points just close, then measure air gap .011 min. between armature and center of core. Adjust, if necessary, by bending the lower contact point support.
2. Large Unit. Press Armature down until lower points just close, then measure air gap .011 - .016 between armature and center of core. Adjust, if necessary, by loosening two armature hinge bracket attaching screws and moving armature up or down as required. Tighten screws firmly after adjustment.

Point Opening - With battery wire off of number 6 terminal, check and adjust each unit as follows:

1. Small Unit. Measure opening between contact points (.025). Adjust, if necessary, by bending armature stop.
2. Large Unit. Measure opening between lower points .023 with upper points closed. Adjust, if necessary, by bending the upper contact point support.

Closing Voltage

Check each unit as follows:

1. Small Unit. Battery wire must be disconnected from number 6 terminal so starter will not operate. Connect an accurate reading voltmeter parallel with the relay operating circuit at terminal numbers 1 and 3. Connect a variable resistance unit in series with the operating circuit at number 3 terminal.

## WIRING MISC. AND ELEC.

or information not listed herein, refer to Maintenance Manual X-5822 for Model PD-4501

Sec. 7A Page 39A  
(continued)

While holding engine compartment "ENGINE START" switch in "REAR START" position, slowly decrease resistance until lower points close and note the voltage reading. Adjust, if necessary, by bending the armature hinge bracket to change tension of the spring-type hinge. Increasing spring tension increases the closing voltage; decreasing spring tension lowers the closing voltage.

2. Large Unit. Connect battery wire to number 6 terminal. Connect an accurate reading voltmeter parallel with the relay operating circuit at terminals 1 and 4. Connect a variable resistance unit in series with operating circuit at number 4 terminal. Start engine and run at fast idle. Slowly decrease resistance until points close and note the voltage reading. (3.3 - 4.2) Adjust, if necessary, by bending the armature spring stop to change tension on spring. Increase spring tension to increase closing voltage; decrease spring tension to lower closing voltage. Remove instruments and make sure wires are all connected and securely tightened after completing adjustment.

Sec. 7A Page 41

information is applicable except:

Delete paragraph entitled "Two-Speed Governor Solenoid Valve"

Sec. 7A Page 42

Information is applicable except:

Delete paragraphs entitled "Two-Speed Clutch Solenoid Valve" and "Clutch Primary and Secondary Solenoid Valves".

Sec. 7A Page 44

Information is applicable except:

Delete paragraphs entitled "Solenoids" at bottom of page.

Sec. 7A Page 45

Information is applicable except:

Delete first two paragraphs covering "Solenoids".

Under "Gauges and Sending Units" bear in mind that the two engine installation has been replaced with one engine. Therefore, only one gauge and unit is used.

WIRING AND MISC. ELEC.

For information not listed herein, refer to Maintenance Manual X-5822 for Model PD-4501

Sec. 7A Page 46

Information is applicable except:

"Engine Temperature Gauge" only gauge in right-hand panel is used.

Sec. 7A Page 50

Information is applicable except:

The third relay "Engine Cut-out Relay" should be changed to:

Make. . . . .	Delco-Remy
Type. . . . .	1116805

Delete the second Solenoid Valve "2 Spd. Governor, Engine Fast Idle, Brake Valve, Clutch Primary and Secondary, and Water Valve Solenoid Valves."

The third Solenoid Valve is no longer used as a 2: Spd. clutch valve but is used in the air conditioning drive.

Under "Solenoids" the first one "Starter Solenoids," is deleted and the vendors number on the second one, "Engine Emergency Stop Solenoid," should be 1118128.

SMALL UNIT

Air gap points closed	.011 min.
Point opening	.025
Closing voltage	8.3 - 10.2
Opening voltage	3.2 max.
Sealing voltage	10.7 max.

LARGE UNIT

Air gap points closed	.011 - .016
Point opening	.023
Closing voltage	3.3 - 4.2
Sealing voltage	0-.9 above closing

## BATTERIES

For information not listed herein, refer to Maintenance Manual X-5822 for Model PD-4501

Sec. 7B Pages 1 and 2

Information is applicable.

Never boost batteries.

Match batteries according to age and specific gravity.

Change batteries in pairs only.

# BATTERIES ARE POSITIVE GROUND

## STARTING SYSTEM

For information not listed herein, refer to Maintenance Manual X-5822 for Model PD-4501

Sec. 7C Pages 1 thru 6

Information is not applicable.

Add:

Starting motor is identified by model number 1114058 stamped on name plate attached to starter field frame. Starter relays are previously covered in "WIRING AND MISCELLANEOUS ELECTRICAL" section. Starting system includes batteries, starter, solenoids, relays starter switches, starter cutout switch, circuit breakers, and wiring. Driver's starter switch circuit is protected by No. 6 circuit breaker on control panel at left of driver. Starter switches on engine compartment control panel are protected by No. 5 circuit breaker in engine compartment control box. Starting system circuits are shown on wiring diagram GBK-10550.

### OPERATION AND CONTROLS

The starting system operation is dependent upon the proper functioning of each unit included in the system. Maintenance and adjustment of starter relay is covered under "Relays" in "WIRING AND MISCELLANEOUS ELECTRICAL" section at the beginning of this group. When starter switch is closed, an electrical circuit is completed through starter relay winding which closes relay points. When points are closed, circuit is completed through windings in solenoid. Solenoid then functions to move starter pinion into mesh with flywheel ring gear. Starter circuit is inoperative when starting switch is in "CUT OUT" position. This switch is in engine compartment panel.

### STARTER DRIVE OPERATION

Pinion is shifted into mesh with the flywheel teeth by centrifugal force when starter switch is held in "Start" position.

#### Operating Position

As starter begins to crank engine, shift sleeve is carried back to its original position by rotation of the armature shaft. When engine fires, accelerating action disengages pinion from flywheel and pinion returns to locked or "at rest" position.

It is impossible to start another cranking operation until complete cranking cycle is finished. After engine fires, shift lever should be allowed to return to "at rest" position: unit is then ready for another cranking operation.

### MAINTENANCE

Under normal operating conditions, no major maintenance will be required between engine overhaul periods. At time of engine overhaul, starting motor should be disassembled, inspected, cleaned, and tested as described in succeeding paragraphs.



## STARTING SYSTEM

ADJUSTABLE NOSE HOUSING

The nose housing attaches to the lever housing by means of six bolts located around the outside of the housing. To relocate the housing, it is only necessary to remove the bolts, rotate the housing to the desired position, and reinstall the bolts. The bolts should be torqued to 13-17 lb. ft. during reassembly. The lever housing and the commutator end frame are attached to the field frame independently by bolts entering threaded holes in the field frame.

FREE SPEED CHECK

To make this check connect a battery in series with an ammeter to the battery terminal of the solenoid (Fig. 4). For the return circuit, connect a lead from the frame of the cranking motor to the battery. Connect a voltmeter from solenoid "BAT" terminal to ground.

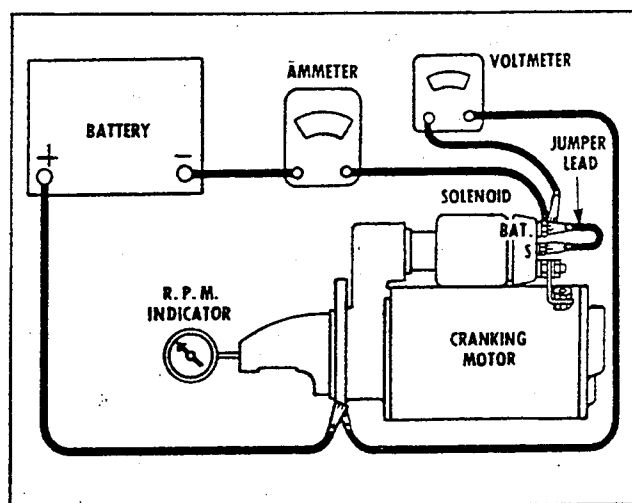


Figure 4 - Circuit for checking motor free speed

A tachometer or any kind of R. P. M. indicator may be used to measure armature revolutions per minute. Energize the solenoid by connecting a jumper lead from the solenoid battery terminal to the solenoid switch terminal, and observe the R. P. M. reading. Failure of the cranking motor to perform according to specifications may be due to tight or dry bearings, or high resistance connections.

PINION CLEARANCE

To check the pinion clearance, connect a 6-volt battery from the solenoid switch terminal to the motor frame. If the solenoid does not operate, use a 12-volt battery. Also, to prevent motoring, connect a heavy jumper from the solenoid motor terminal to the motor frame (fig. 5).

With the solenoid energized push the pinion back toward the commutator end as far as possible to take up any slack movement, then check the clearance between pinion and housing.

## STARTING SYSTEM

PINION CLEARANCE  
(continued)

The clearance is adjustable, and can be accomplished by removing the plug on the lever housing and turning the nut on the plunger rod inside the housing. Turn the nut clockwise to decrease the clearance and counterclockwise to increase the clearance (Fig. 7).

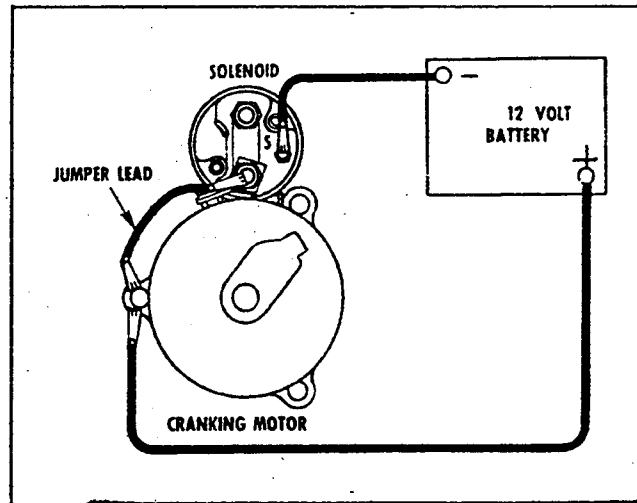


Figure 5 - Circuit for checking pinion clearance

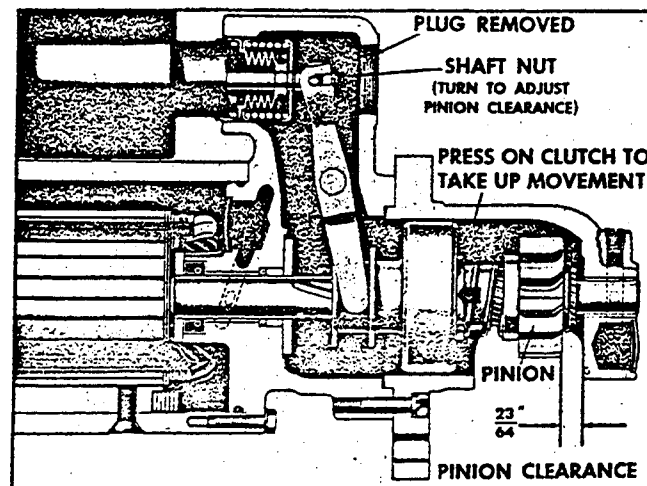


Figure 7 - Checking pinion clearance on heavy duty clutch motor.

## STARTING SYSTEM

DISASSEMBLY

Normally the cranking motor should be disassembled only so far as is necessary to make repair or replacement of the defective parts. As a precaution, it is suggested that safety glasses be worn when disassembling or assembling the cranking motor.

1. Note the relative position of the solenoid, lever housing, and nose housing so that motor can be reassembled in the same manner.
2. Disconnect field coil connector from solenoid motor terminal, and lead from solenoid ground terminal.
3. On motors which have brush inspection plates, remove the plates and then remove the brush lead screws. This will disconnect the field leads from the brush holders.
4. Remove the attaching bolts and separate the commutator end frame from the field frame.
5. Separate the nose housing and field frame from lever housing by removing attaching bolts.
6. Remove armature and clutch assembly from lever housing.
7. Separate solenoid from lever housing by pulling apart.

CLEANING

The overrunning clutch, armature and fields should not be cleaned in any degreasing tank, or with grease dissolving solvents, since these would dissolve the lubricant in the clutch mechanism and damage the insulation in the armature and field coils. All parts except the clutch should be cleaned with oleum spirits and a brush. The clutch can be wiped with a clean cloth.

If the commutator is dirty it may be cleaned with No. 00 sandpaper. NEVER USE EMERY CLOTH TO CLEAN COMMUTATOR.

ARMATURE SERVICING

If the armature commutator is worn, dirty, out of round, or has high insulation, the armature should be put in a lathe so that commutator can be turned down. The insulation should then be undercut  $1/32$  of an inch wide and  $1/32$  of an inch deep, and the slots cleaned out to remove any trace of dirt or copper dust. As a final step in this procedure, the commutator should be sanded lightly with No. 00 sandpaper to remove any burrs left as a result of the undercutting procedure.

## STARTING SYSTEM

ARMATURE SERVICING

(continued)

The armature should be checked for opens, short circuits and grounds as follows:

1. Opens --- Opens are usually caused by excessively long cranking periods. The most likely place for an open to occur is at the commutator riser bars. Inspect the points where the conductors are joined to the commutator bars for loose connections. The poor connections cause arcing and burning of the commutator bars as the cranking motor is used. If the bars are not too badly burned, repair can often be affected by resoldering the leads in the riser bars (using rosin flux), and turning down the commutator in a lathe to remove the burned material. The insulation should then be undercut.
2. Short Circuits --- Short circuits in the armature are located by use of a growler. When the armature is revolved in the growler with a steel strip such as a hacksaw blade held above it, the blade will vibrate above the area of the armature core in which the short circuit is located. Shorts between bars are sometimes produced by brush dust or copper between the bars. These shorts can be eliminated by cleaning out the slots.
3. Grounds --- Grounds in the armature can be detected by the use of a 110-volt test lamp and test points. If the lamp lights when one test point is placed on the commutator with the other point on the core or shaft, the armature is grounded. Grounds occur as a result of insulation failure which is often brought about by overheating of the cranking motor produced by excessively long cranking periods or by accumulation of brush dust between the commutator bars and the steel commutator ring.

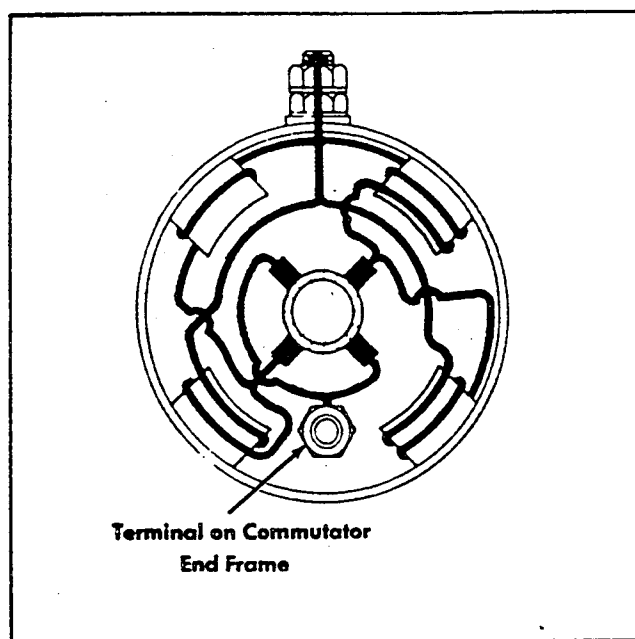


Figure 9 - Wiring diagram

## STARTING SYSTEM

### FIELD COIL CHECKS

The various types of circuits used are shown in the wiring diagrams of Figure 9. The field coils can be checked for grounds and opens by using a test lamp.

Grounds - If the motor has one or more coils normally connected to ground, the ground connections must be disconnected during this check. Connect one lead of the 110-volt test lamp to the field frame and the other lead to the field connector. If the lamp lights, at least one field coil is grounded which must be repaired or replaced.

Opens - Connect test lamp leads to ends of field coils. If lamp does not light, the field coils are open.

### FIELD COIL REMOVAL

Field coils can be removed from the field frame assembly by using a pole shoe screw driver. A pole shoe spreader should also be used to prevent distortion of the field frame. Careful installation of the field coils is necessary to prevent shorting or grounding of the field coils as the pole shoes are tightened into place. Where the pole shoe has a long lip on one side and a short lip on the other, the long lip should be assembled in the direction of armature rotation so it becomes the trailing (not leading) edge of the pole shoe.

### REASSEMBLY

The reassembly procedure for each type of motor is the reverse of disassembly. To reassemble the end frame having eight brushes onto the field frame, pull the

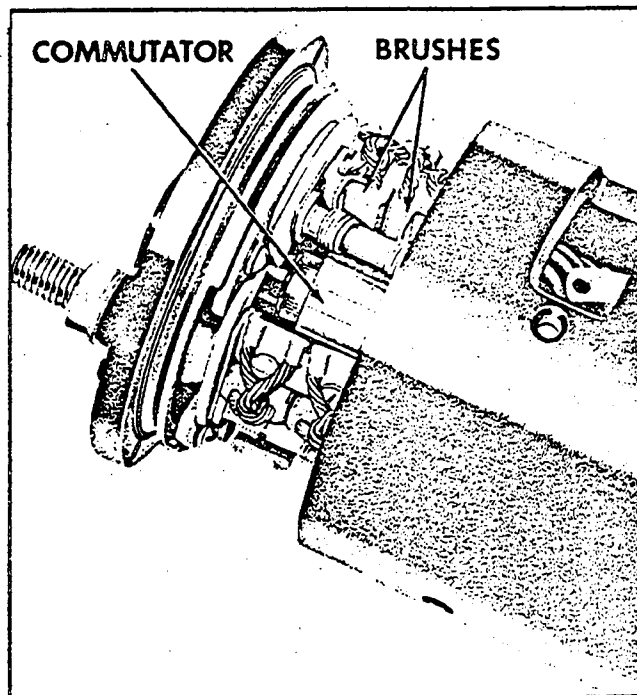


Figure 14 - Assembling end frame with eight brushes to field frame.

## STARTING SYSTEM

REASSEMBLY.  
(continued)

armature out of the field frame just far enough to permit the brushes to be placed over the commutator (Fig. 14). Then push the commutator end frame and the armature back against the field frame.

LUBRICATION

All wicks and oil reservoirs should be saturated with SAE #10 oil, and the splines underneath the clutch should be lubricated with a light coat of SAE #10 oil. (Heavier oil may cause failure to mesh at low temperatures.)

STARTER SOLENOID

Starter solenoid is used to shift the starter drive pinion into engagement with flywheel teeth and to complete the circuit from battery to starter.

Solenoid has two windings, the pull-in winding and the hold-in winding. When starter switch is closed, both windings are energized, producing a magnetic field which pulls the plunger in. Inward movement of plunger shifts starter pinion into engagement with flywheel ring gear teeth, and closes the main contacts in the solenoid switch to complete the circuit from battery to starter.

The pull-in winding draws comparatively heavy current for a short interval. This is required to shift the pinion into engagement. The hold-in winding also aids the pull-in winding. As soon as plunger closes the main switch contact, pull-in winding is de-energized and only the hold-in winding draws current for the balance of the starting cycle.

SOLENOID MAINTENANCE

Solenoid requires no periodic maintenance other than keeping the terminals clean and tight. Always check action of solenoid if it has been removed. If unit fails to function, first check wiring before condemning the solenoid. Solenoid windings can be checked for current draw, open circuit, or shorts. Refer to "Specifications" at end of this section for current values. Solenoid coil, terminals, and switch plunger can be replaced if burned or otherwise damaged. Whenever solenoid is replaced, pinion clearance must be checked and adjusted, if necessary, as previously directed in starter assembly procedures.

SPECIFICATIONS

## Starter

Make

Model

Rotation-Viewed at drive end

Brush Spring Tension

Delco-Remy

1114058

Clockwise

35 oz. Min.

## STARTING SYSTEM

SPECIFICATIONS

(continued)

## No Load Test

Maximum Amps. (Includes Solenoid)	170
Volts	11.2
Approximate R. P. M.	7100

## Lock Test:

Amps	700
Min. Torque (Lb. - Ft.)	15
Approximate Volts	1.5

## Starter Solenoid Model

1119879

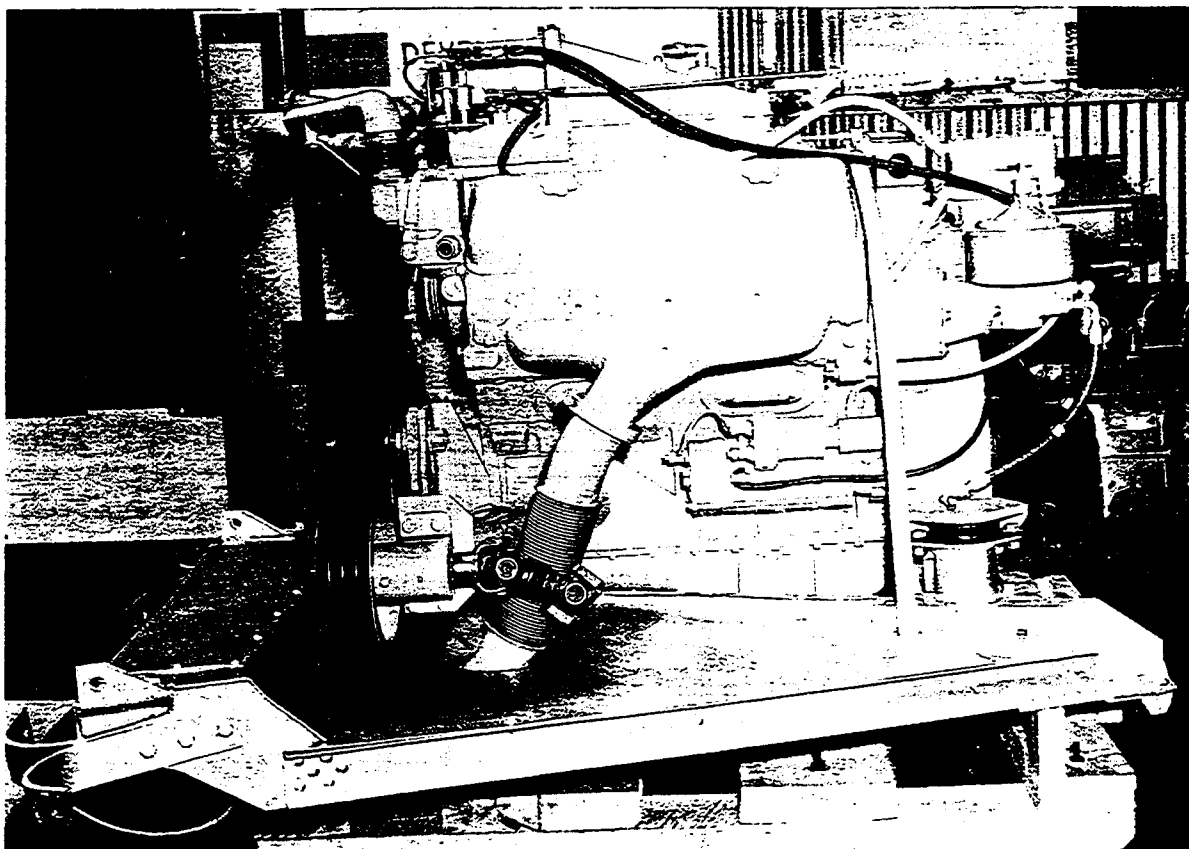
## Current Consumption @80° F.

## Both Windings

Amperes	78.5-87.8
Volts	12

## Hold-in Winding

Amperes	15.2-17.1
Volts	12



## AC GENERATOR (Oil-Cooled Type)

For information not listed herein, refer to Maintenance Manual X-5822 for Model PD-4501

Sec. 7D Pages 1 thru 5

Information is not applicable.

Use the following:

CAUTION: Turn battery master switch to "OFF" position before attempting generator removal or generator repairs.

### GENERATOR REMOVAL

1. Disconnect and remove engine cradle assembly from coach.
2. Disconnect all lines and cable from generator.
3. Remove generator and gear box assemblies.
4. Do not disturb generator adapter plate unless necessity demands. If adapter must be removed, loosen three dog point set screws and remove plate from block.

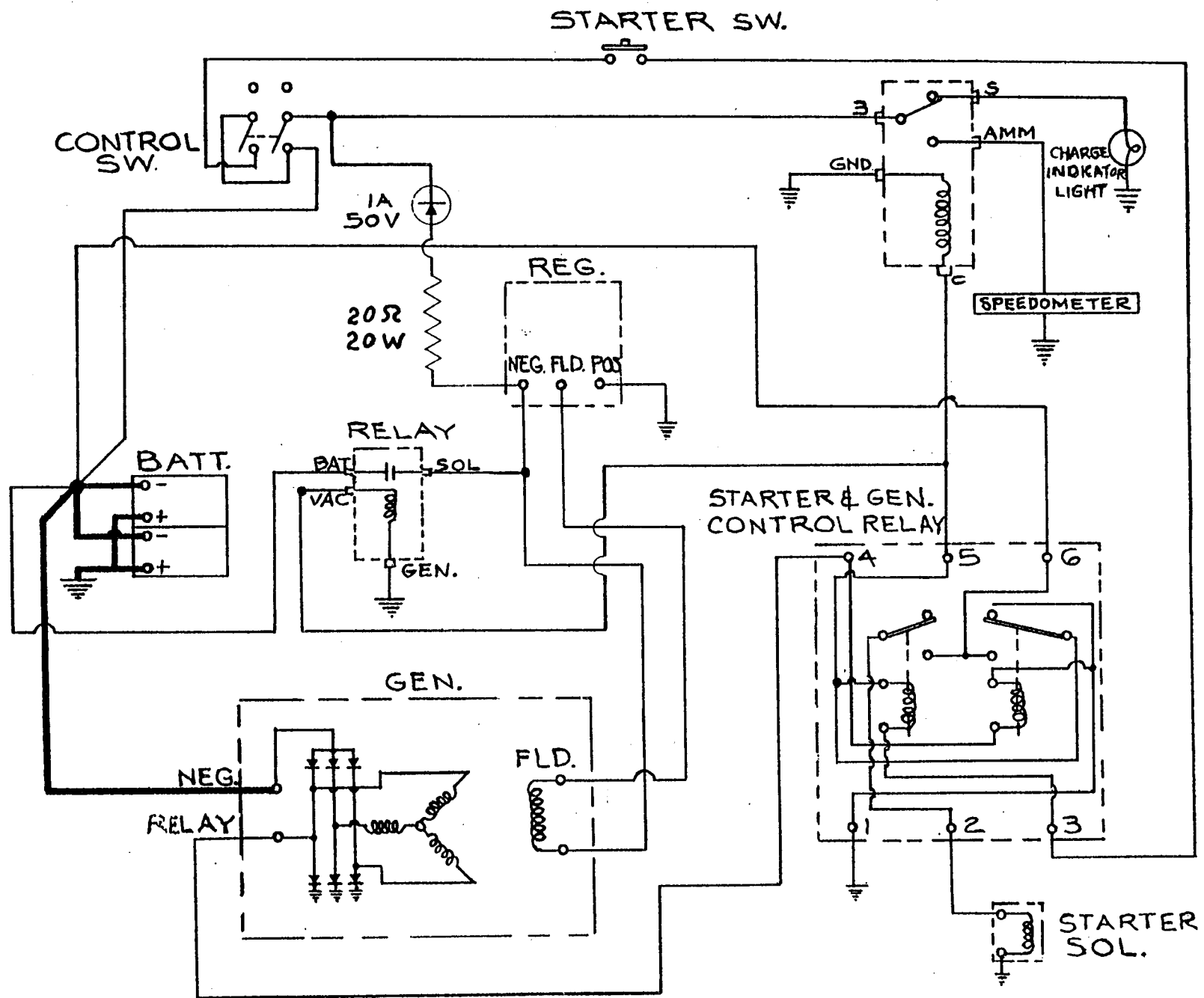
CAUTION: Use care that nothing is permitted to drop into engine block while this opening is exposed.

### GENERATOR INSTALLATION

1. If generator adapter plate has been removed, Tool Kit G1GBK-11292 must be used for proper installation.
2. Use new gaskets and new Allen screws in assembly operation. Install generator adapter plate but tighten Allen screws only enough to hold plate loosely in position. Leave the three small set screws loose. CAUTION: Use special vise grips when inserting or removing tool shafts. Install long shaft and plug of tool kit and center adapter plate. If shaft will not enter camshaft, do not force but lightly hand ream camshaft with 1/2" reamer to remove internal burrs. DO NOT GRIND TOOL SHAFT. Tighten Allen screws to snug plate in position. Move tool shaft back and forth end ways to assure tool is not under bind. Remove tool shaft and plug.

Install short shaft of tool kit in end of camshaft and mount dial indicator. Turn indicator one revolution. Total run-out should not exceed .002". Tap plate with soft hammer to make necessary compensation and bring reading within tolerance. Remove the bottom Allen screw, coat threads with No. 2 Permatex, and reinstall. Tighten Allen screws securely (85 ft. lbs. torque) and tighten three small set screws. Make final tolerance check.





CHARGING SYSTEM WIRING DIAGRAM

## AC GENERATOR (Oil-Cooled Type)

GENERATOR INSTALLATION  
(continued)

3. Install generator and gear box assemblies.
4. Install and connect engine cradle in coach.
5. Connect lines and cables to generator and generator gear box. CAUTION: Double check that all cables are connected to proper terminals prior to turning the battery master switch to the "ON" position.

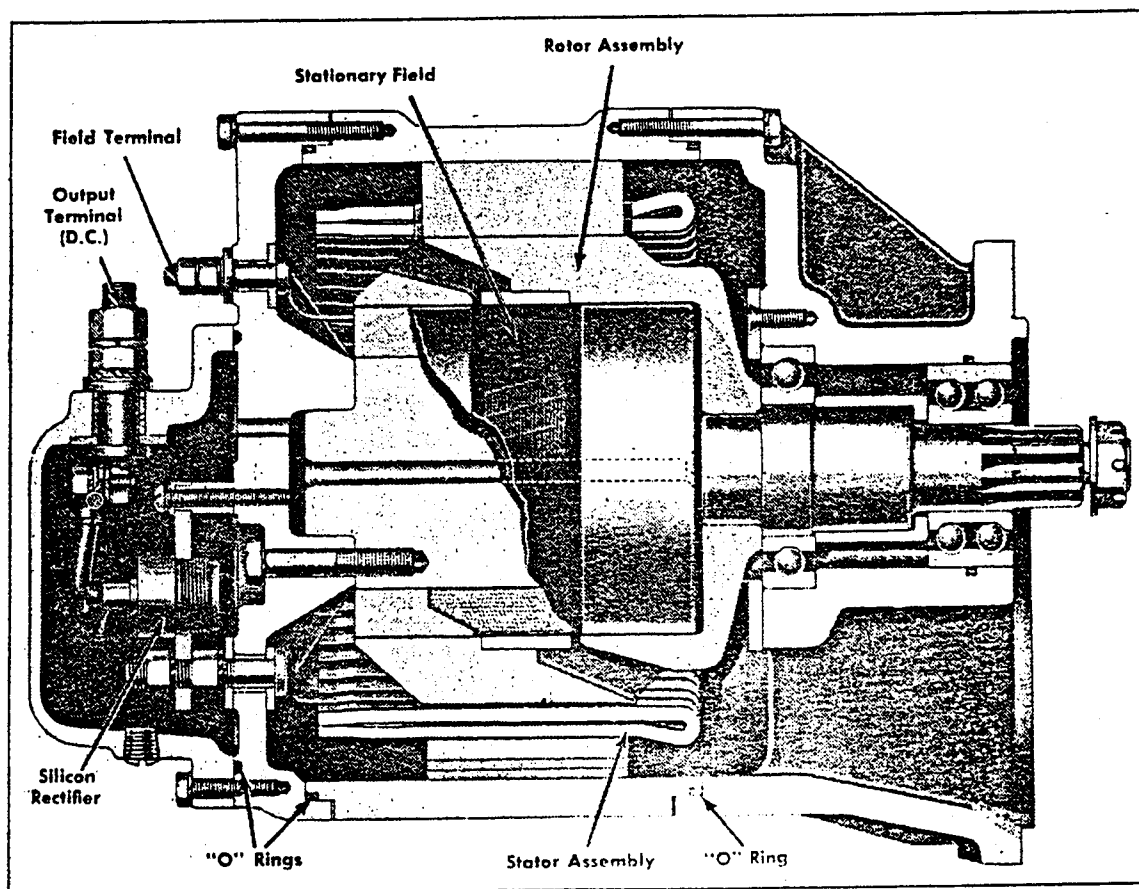


Figure 1 - Typical oil-cooled AC generator

TESTS

The oil-cooled AC generator (Fig. 1) is a totally enclosed, self-rectifying, brushless unit in which all current-carrying conductors are stationary. The only movable part is the rotor, which is mounted on two ball bearings located in the drive end frame. A continuous flow of engine oil circulates through the generator to lubricate the bearings and to cool the generator (Fig. 2). Since there are no brushes, slip rings, or rubbing seals, no periodic maintenance is required.

## AC GENERATOR (Oil-Cooled Type)

TEST (continued)

The current-carrying conductors in the generator are the field winding, the stator windings and six diodes. The field winding assembly is attached to the rectifier end frame by four attaching bolts. The stator windings are assembled inside the laminations and stator frame, and are connected electrically to the six diodes which together comprise the rectifier. The D. C. output terminal on the generator end frame is connected to the rectifier.

Two field terminals are used on the generator.

A relay terminal is used to energize a control relay in the electrical system. For wiring details of this circuit, reference should be made to the wiring diagram.

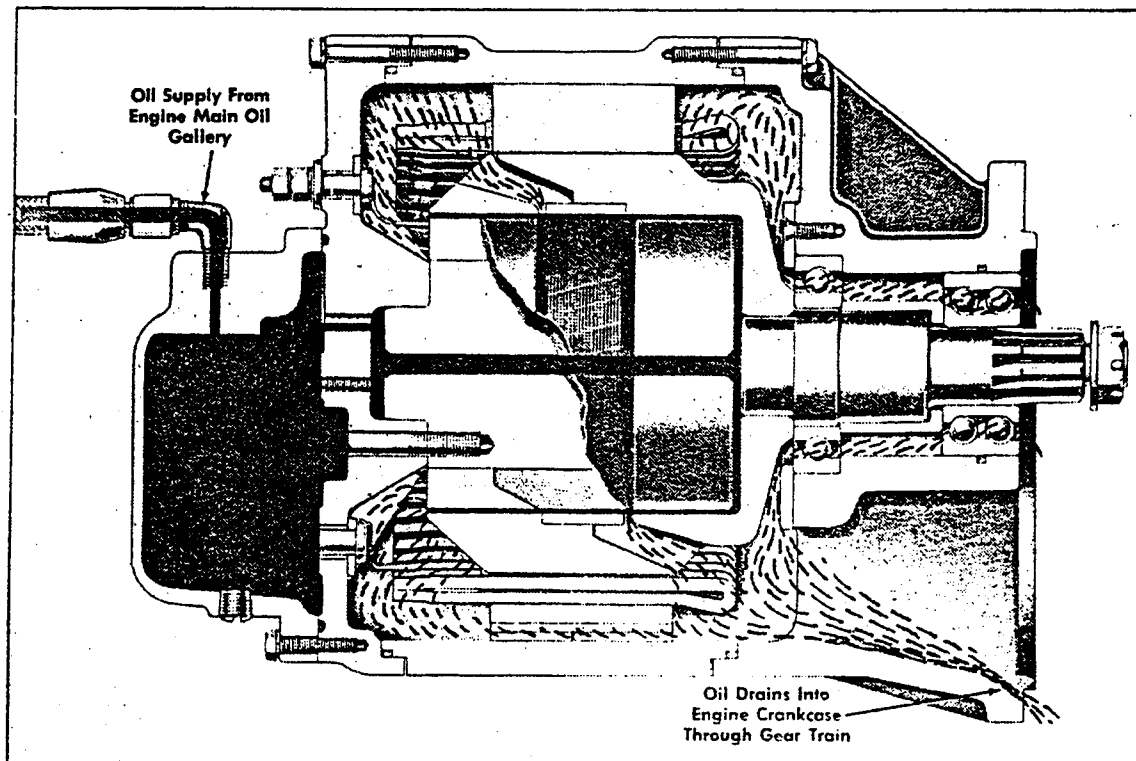


Figure 2 - Cross sectional view showing oil circulation

GENERATOR TROUBLESHOOTING PROCEDURES

**CAUTION** - The generator is designed for use on a positive ground system. If a negatively grounded battery is connected to a positive ground generator, the generator and wiring will be instantly damaged. Always make sure the battery and generator polarities are matched before making connections. Also, do not ground or short across any of the generator or regulator terminals.

## AC GENERATOR (Oil-Cooled Type)

GENERATOR TROUBLESHOOTING PROCEDURES  
(continued)

There are three components in the generator which require electrical checks - the field winding, the six diodes, and the stator windings. CAUTION: BEFORE CHECKING THE GENERATOR, DISCONNECT THE BATTERY GROUND STRAP.

Field Winding

The field winding may be checked for shorts, grounds, and opens with an ohmmeter. Disconnect all leads from the field terminals and connect an ohmmeter across the terminals. A resistance reading above normal indicates an open, and a resistance reading less than normal indicates a short. The normal resistance can be calculated by dividing the voltage by the field current. The normal resistance value should be at or near mid-scale on the ohmmeter for accuracy. An alternate method of checking for a short or open is to connect a battery of specified voltage and an ammeter in series with the field winding and compare readings with published specifications. To check for a ground, connect the ohmmeter from either field terminal to ground. A reading equal to or less than the normal resistance value indicates a ground.

Checking Diodes.

Each diode can be checked for shorts and opens with the generator mounted on the engine. To prepare the generator for checking, proceed as follows:

1. Check to make sure the battery ground strap is disconnected.
2. Remove the cable and both nuts and washers from the D. C. terminal on the generator, and also from the relay terminal.
3. On generators so equipped, remove the plug from the underneath side of the rectifier end cover to drain the oil in the rectifier compartment. This will remove about one quart of oil from the engine oil supply.
4. Remove the attaching screws and separate the rectifier end cover from the generator. It may be necessary to detach the oil line from the end cover in order to complete the separation. IMPORTANT - Do not operate the generator unless the unit is completely assembled and the oil line is connected.
5. Detach the D. C. terminal and relay terminal and disconnect the diode leads from the supports.

Each diode can be checked for shorts and opens with an ohmmeter as illustrated in Figures 4 and 5. IMPORTANT - The ohmmeter polarity must be determined by connecting its leads to voltmeter leads. The voltmeter will read up scale when the negative leads are connected together and the positive leads are connected together. The polarity of the voltmeter leads can be determined by connecting the leads to the identified terminals of a battery. An ohmmeter with 1-1/2 volt cell should be used. Select a scale on which the 300 ohm value lies within the middle third of the scale.

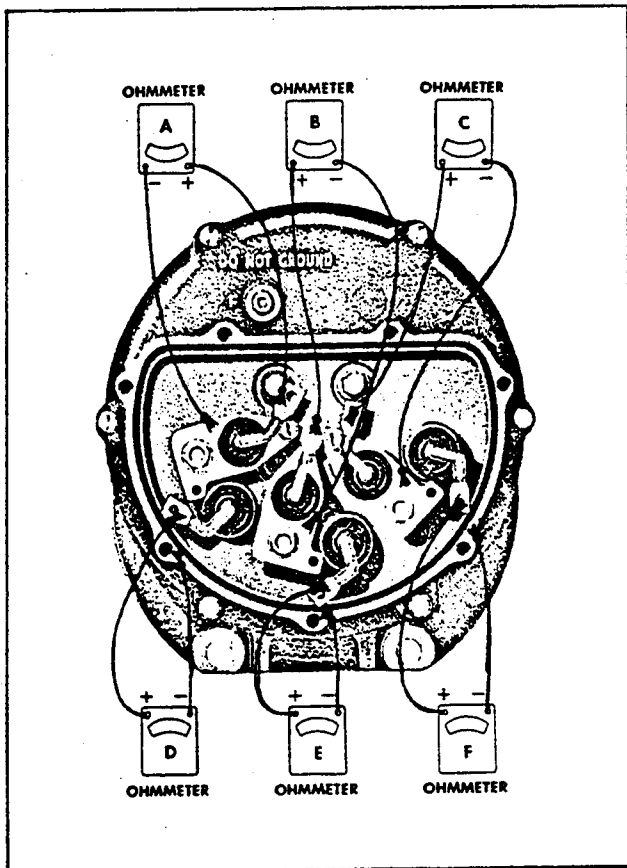
# AC GENERATOR (Oil-Cooled Type)

## Checking Diodes (continued)

To check the diodes mounted in the diode supports for shorts, connect the ohmmeter negative lead to each diode lead and the ohmmeter positive lead to each support as shown in parts A, B and C in Figure 5. To check the diodes mounted in the end frame for shorts, connect the ohmmeter negative lead to each diode lead and the ohmmeter positive lead to the end frame as shown in parts D, E and F in Figure 5.

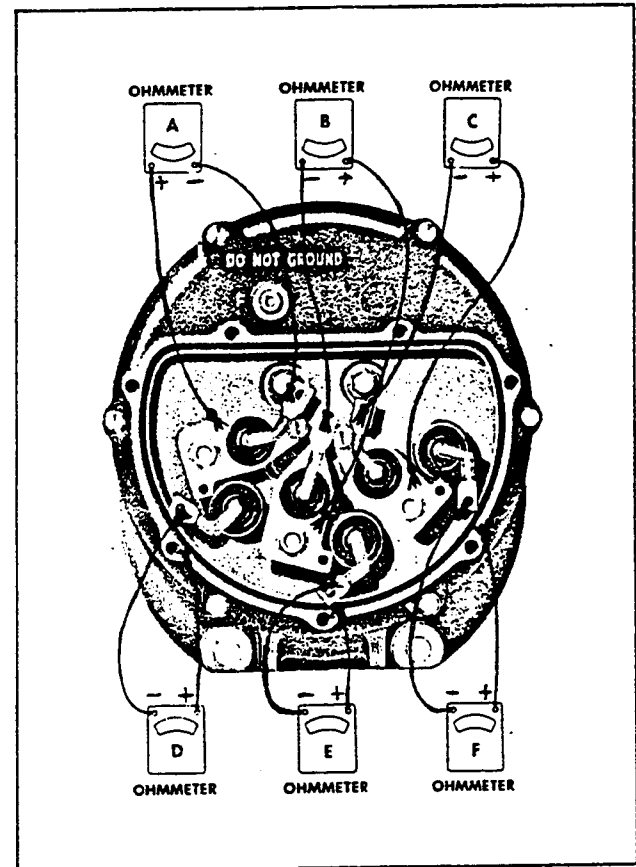
Ohmmeter readings may vary considerably when checking diodes for shorts, but if the reading is 300 ohms or less, the diode most likely is defective and should be replaced. A reading of 300 ohms or less will allow excessive reverse current from the battery.

**CHECKING DIODES MOUNTED IN SUPPORTS**  
For opens on positive ground generators



**CHECKING DIODES MOUNTED IN END FRAME**  
For opens on positive ground generators

**CHECKING DIODES MOUNTED IN SUPPORTS**  
For shorts on positive ground generators



**CHECKING DIODES MOUNTED IN END FRAME**  
For shorts on positive ground generators

Fig. 4 - Checking diodes with ohmmeter

Fig. 5 - Checking diodes with ohmmeter

## AC GENERATOR (Oil-Cooled Type)

Checking Diodes (continued)

To check the diodes mounted in the diode supports for opens, connect the ohmmeter positive lead to each diode lead and the ohmmeter negative lead to each support as shown in parts A, B and C in Figure 4. To check the diodes mounted in the end frame for opens, connect the ohmmeter positive lead to each diode lead and the ohmmeter negative lead to the end frame as shown in parts D, E and F in Figure 4. An infinite resistance reading indicates an open diode.

CAUTION: Diodes can be replaced by following the procedure outlined in the sections entitled "Disassembly" and "reassembly." When installing the diode, coat the threads with silicone grease or light engine oil and torque to 240 inch pounds. Re-stake next to the threads in an arbor press with a 1/8 inch round punch. Press the punch with gradual pressure; do not strike as the shock may damage the diodes.

Stator Winding Checks

The stator windings may be checked for opens and grounds with an ohmmeter as follows:

Opens - Connect the ohmmeter leads to the two pairs of diode supports as shown in parts A and B in Figure 6. The ohmmeter should show a low resistance. If an infinite or high resistance is obtained in either one or both of the checks, the stator windings are open.

Grounds - To check for grounds, connect an ohmmeter as illustrated in Part C in Figure 6. The ohmmeter should show an infinite or very high resistance. If a zero or very low resistance reading is obtained, the windings are grounded.

The stator windings are difficult to check for shorts without laboratory test equipment due to the very low resistance of the windings. However, if all other generator checks are satisfactory, yet the generator fails to perform according to specifications, shorted stator windings are indicated.

DISASSEMBLY

The generator can be disassembled by following the steps outlined below:

1. Remove nuts and washers from D. C. terminal on rectifier end cover.
2. Separate the rectifier end cover from the rectifier end frame by removing the attaching bolts.
3. Remove the three screws attaching the diode supports to the rectifier end frame, the three screws connecting the diode leads to the diode supports, and the three nuts which attach the stator studs to the diode supports.
4. Separate the diode support assemblies from the rectifier end frame, and the three nuts which attach the studs to the rectifier end frame.
5. Mark the position of the drive end frame and rectifier end frame with respect to the stator assembly so the parts can be reassembled in the same position.

## AC GENERATOR (Oil-Cooled Type)

DISASSEMBLY  
(continued)

6. Detach the rectifier end frame and field assembly from the stator assembly by removing the attaching screws.
7. Separate the field assembly from the rectifier end frame by removing the four attaching screws.
8. Separate the rotor assembly and drive end frame from the stator assembly by removing the attaching screws.
9. Press the rotor shaft out of the drive end frame. Remove the retainer plate and pull the bearings from the drive end frame.

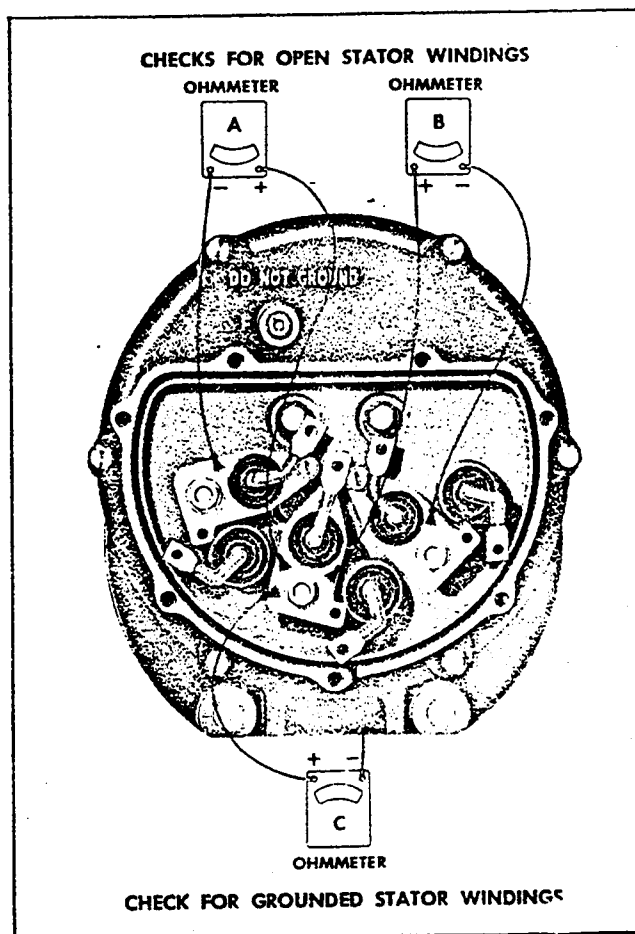


Figure 6 - Checking stator windings for opens and grounds

REASSEMBLY

Reassembly is the reverse of disassembly. When installing the single row bearing into the drive end frame, press against the outer race only to avoid loading the bearings. Attach the bearing retainer plate, and press against the bearing inner race to force the assembly over the shaft. To avoid pressure on the bronze ring in the rotor, support the inside of the rotor against the shaft, and place the

## AC GENERATOR (Oil-Cooled Type)

REASSEMBLY  
(continued)

shaft in an upright position to facilitate the assembly procedure. Press against the inner race to force the double row bearing over the shaft. When attaching the field to the rectifier end frame, make sure the mating surfaces are perfectly clean, and tighten the attaching screws securely.

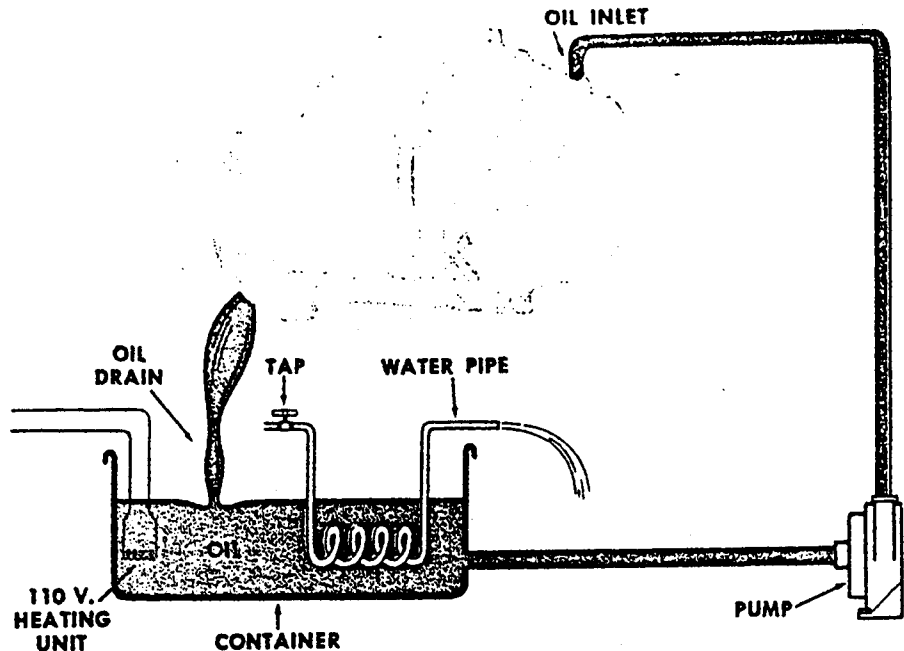


Figure 7 - Method of providing circulating oil.

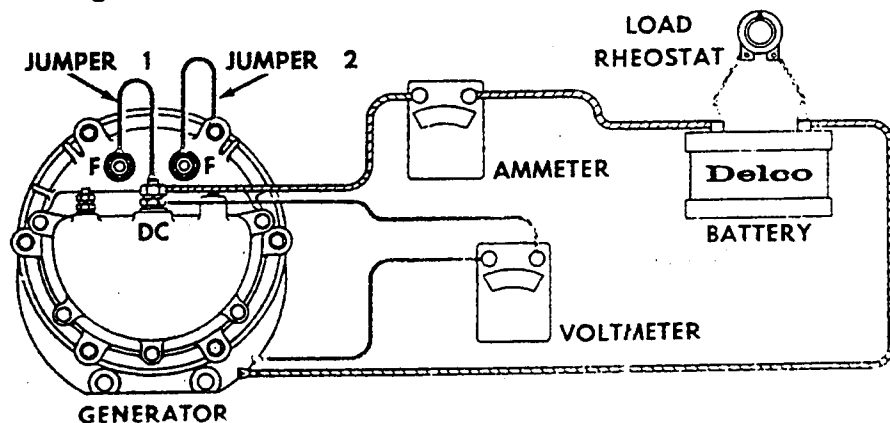


Figure 8 - Electrical connections for checking generator output.

OFF-THE VEHICLE TESTSOUTPUT CHECK

When removed from the engine, the generator may be checked on a test bench without



## AC GENERATOR (Oil-Cooled Type)

OFF-THE VEHICLE TESTS  
(continued)

circulating oil provided the output is limited to 100 amperes or less. Also, the generator may be checked without circulating oil at outputs exceeding 100 amperes provided the period of operation is limited to 15 seconds. Operating the generator at output greater than 100 amperes for periods exceeding 15 seconds will cause the generator to overheat, resulting in damage to the windings and diodes.

If the assembly is to be operated at an output greater than 100 amperes for periods exceeding 15 seconds, circulating oil must be provided. SAE #30 oil should be used, and must be supplied to the generator at a pressure of 35 psi and at a temperature of 180° - 220° F. This will provide an oil flow of about one gallon per minute.

An arrangement for providing circulating oil is shown in Figure 7. A coil of tubing, connected to tap water and immersed in the oil, can be used for cooling purposes. Before the test is made, the oil should be heated to 180° F by immersing a 110 volt heating element into the oil. The oil inlet hole on most generator models has 1/8-27 N. P. T. F. threads.

To check the generator on a test bench, make electrical connections as shown in Figure 8, operate at specified speed, and check for rated output as given in Delco-Remy Service Bulletin 1G-186. Adjust the load rheostat, if necessary, to obtain the desired output. If the generator has only one field terminal, jumper #2 is not used. CAUTION: On negative ground generators, connect the negative battery post to the generator frame, and on positive ground generators connect the positive battery post to the generator frame.

## QUICK-CHECKS FOR MARMON-HERRINGTON OIL-COOLED GENERATOR-TRANSISTOR-REGULATOR SYSTEM

If the 9000551 regulator voltage setting cannot be adjusted to correct an undercharged or overcharged battery condition, the following quick-checks may be helpful in locating trouble in the Oil-Cooled Generator or Transistor Regulator.

1. Undercharged battery (Control Switch on; engine not running)
  - a. If no voltage between regulator "NEG" and "POS" terminals, repair or replace wiring, control switch, 20 ohm resistor, or diode connected to 20 ohm resistor.
  - b. If battery voltage between regulator "FLD" and "POS" terminals, repair regulator per 1R-254.
  - c. If above checks are O. K. , repair generator per 1G-254.
2. Overcharged battery (Control Switch on; engine not running)
  - a. If no voltage between regulator "POS" terminal and lead detached from "FLD" terminal, repair generator per 1G-254.
  - b. Otherwise repair regulator per 1R-254.

## AC GENERATOR (Oil-Cooled Type)

### QUICK-CHECKS FOR MARMON-HERRINGTON OIL-COOLED GENERATOR-TRANSISTOR-REGULATOR SYSTEM (continued)

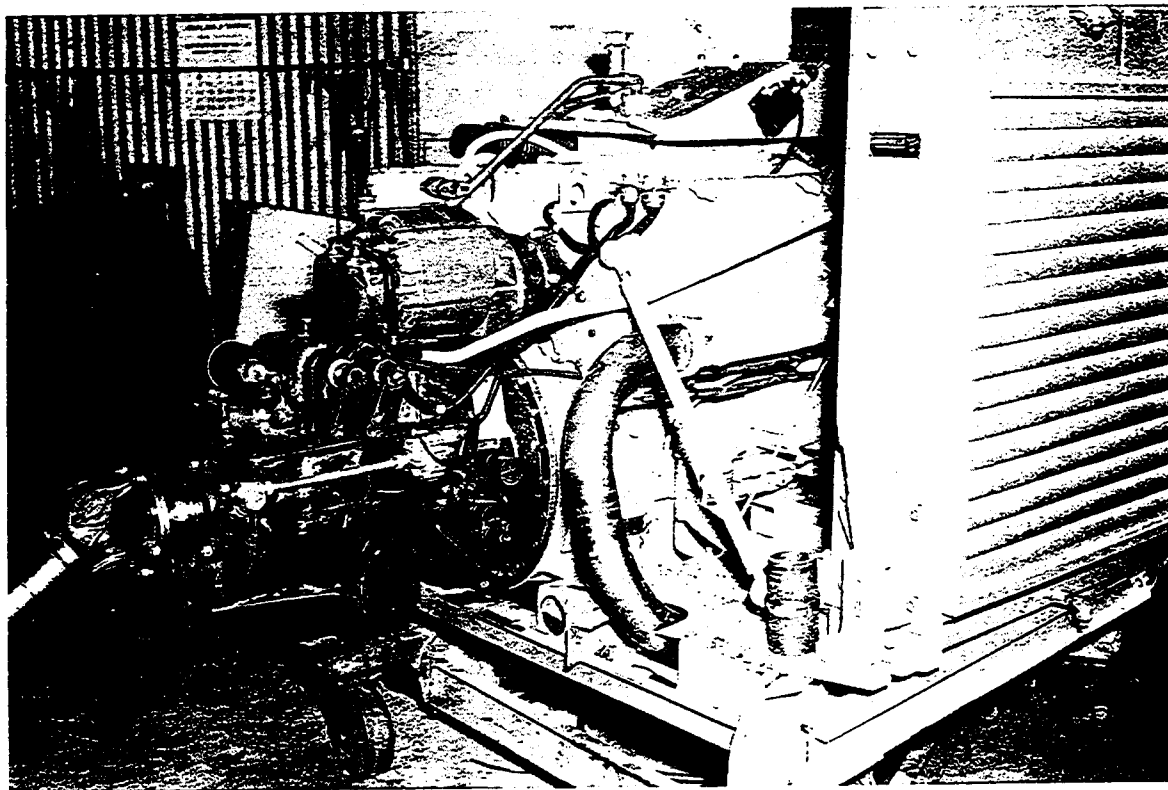
#### 3. Bench Checks

##### a. Oil-Cooled Generator

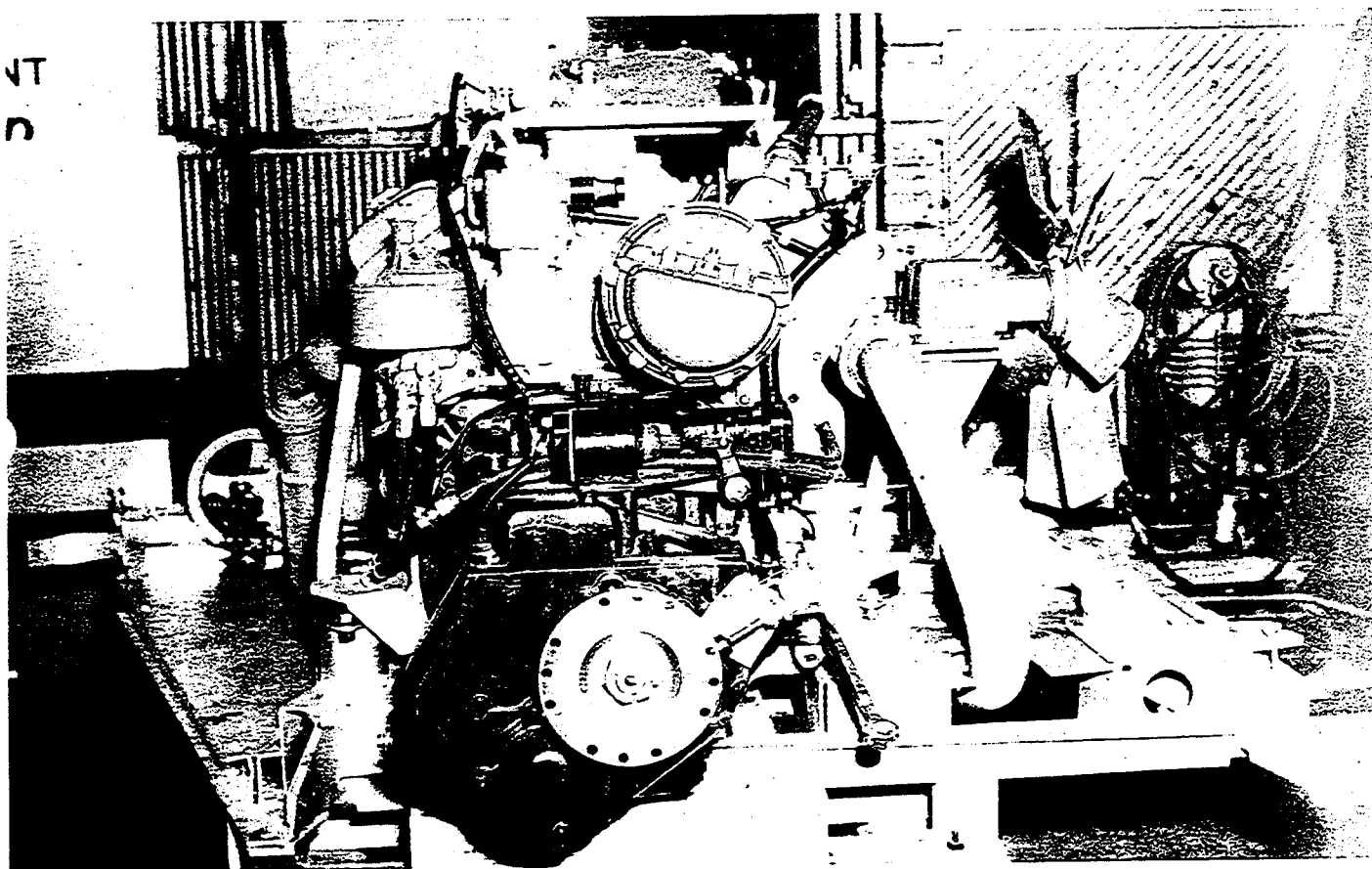
1. Check field resistance. It should be 1.4 - 1.6 ohms. Also, connect ohmmeter from either field terminal to ground. Reading should be infinite.
2. Diodes - With end cover off, disconnect all six diode leads. Check each diode by connecting the ohmmeter across it and then reversing the ohmmeter leads. If both readings on one diode are very high or very low, replace the diode.
3. Ohmmeter should show zero resistance between all the stator terminals.
4. Ohmmeter should show infinite resistance between any stator terminal and ground. If resistance is less than infinite, stator is grounded.

##### b. Transistor Regulator

1. Check for loose or open solder connections.
2. Follow procedure outlined in 1R-254.



AC GENERATOR (Oil-Cooled Type)



## VOLTAGE REGULATION

For information not listed herein, refer to Maintenance Manual X-5822 for Model PD-4501

Sec. 7E Pages 1 thru 12

Information is not applicable

Add:

### TRANSISTOR REGULATORS (Three-Transistor Type)

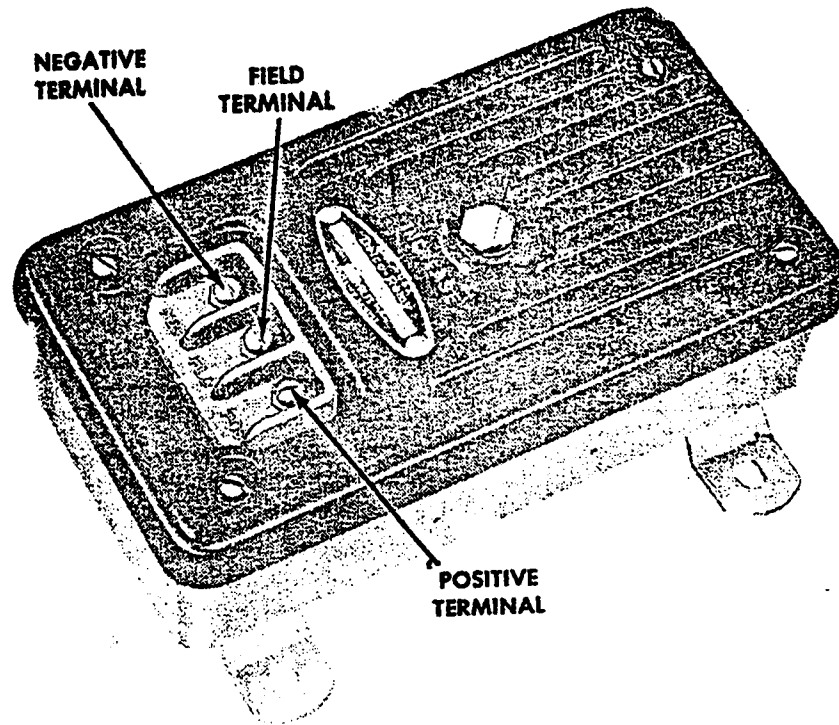


Figure 1 - Typical transistor regulator.

### TESTS AND ADJUSTMENTS

The transistor regulator illustrated in Figure 1 is an assembly composed principally of diodes, condensers, resistors, and three transistors. These components are mounted on a printed circuit panel board to form a completely static unit containing no moving parts. Regulators of this type have terminals marked "NEG," "FLD," and "POS."

The regulator components work together to limit the generator voltage to a preset value by controlling the generator field current. This is the only function the regulator performs in the charging circuit.

The voltage at which the generator operates is determined by the regulator adjustment. Once adjusted, the generator voltage remains constant, since the regulator is unaffected by length of service, changes in temperature, or changes in generator output and speed.

## VOLTAGE REGULATION

## TESTS AND ADJUSTMENTS

(continued)

A typical wiring diagram of a positive ground system is shown in Figure 3. This diagram shows only the basic charging system components, and do not show any components such as control relays.

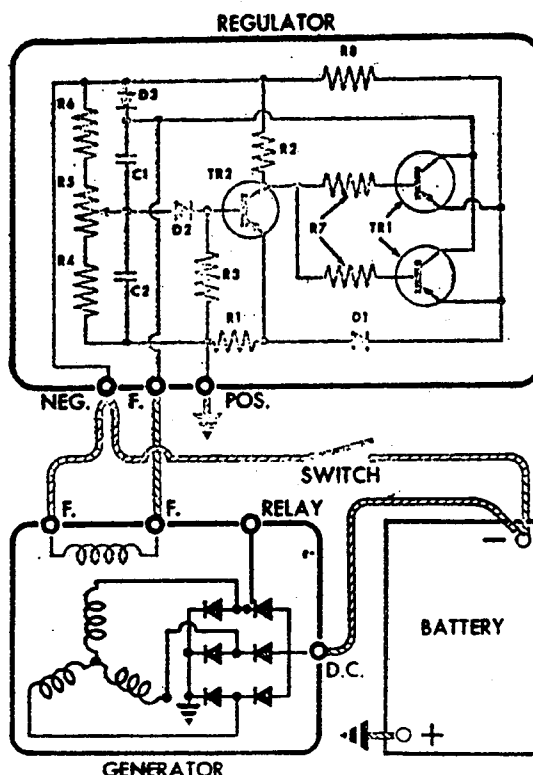


Figure 3 - Typical positive ground wiring diagram showing internal circuits.

### TROUBLESHOOTING PROCEDURES

Trouble in the electrical system will usually be indicated by one of two conditions an undercharged battery or an overcharged battery. Either condition can result from an improper voltage regulator setting.

The ideal voltage setting is the one which will maintain the batteries in a fully charged condition with a minimum use of water. A record of water usage and battery specific gravity checks over a service period of reasonable length will establish the ideal voltage setting for the vehicle involved.

#### Checking Voltage Setting

To check the voltage setting on Positive Ground Systems, connect a voltmeter across the "Pos" and "Neg" terminals on the regulator, and an ammeter at the D. C. Terminal on the generator. Operate the engine at approximately 1000 R. P. M. (about 2300 generator R. P. M.) with accessories turned on to obtain 20-200 amperes generator output, and note the voltage setting. The voltage should

## VOLTAGE REGULATION

Checking Voltage Setting (continued)

be steady and reasonably close to the published specification. Desired variations from the published setting can be obtained by removing the plug from the voltage regulator cover and turning the adjusting screw inside the regulator (Fig. 5). This will change the voltage to meet the needs of vehicles as dictated by operating conditions.

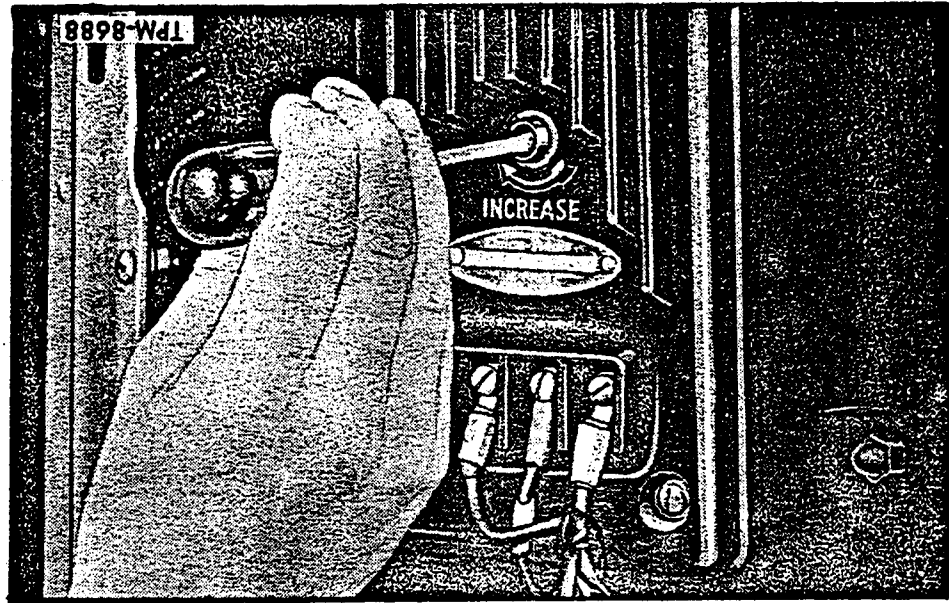


Figure 5 - Adjusting Regulator Voltage Setting

Undercharged Battery: If the voltage setting as checked above is steady and reasonably close to the specified value and the battery is undercharged, raise the setting by .3 volt and check for an improved battery condition over a minimum service period of 48 hours. If the voltage cannot be adjusted to the desired value, the generator should be checked as follows:

1. Stop generator, turn off all accessories and disconnect battery ground strap.
2. Disconnect all leads from the regulator and from the generator field. DO NOT ALLOW LEADS TO TOUCH GROUND.
3. Connect a voltmeter and ammeter in the circuit at the D. C. terminal on the generator.
4. Connect a jumper lead from the generator D. C. terminal to the generator field terminal. Ground the other field terminal.
5. Connect a carbon pile load across the battery. Turn to off position.
6. See Figure 6 and Figure 7 for wiring connections.
7. Reconnect battery ground strap.
8. Turn on all vehicle accessories.
9. Operate generator and adjust carbon pile load as required to check for rated output.
10. Check the generator field winding as follows:

Generators with two field terminals: Disconnect all leads from the field terminals

## VOLTAGE REGULATION

and connect an ohmmeter across the terminals. A resistance reading above normal indicates an open, and a resistance reading less than normal indicates a short. The normal resistance value should be at or near mid-scale on the ohmmeter for accuracy. An alternate method of checking for a short or open is to connect a battery of specified voltage and an ammeter in series with the field winding and compare readings with published specifications. To check for a ground, connect the ohmmeter from either field terminal to ground. A reading equal to or less than the normal resistance value indicates a ground.

The generator is defective if it does not produce rated output or if field windings are faulty. If the generator provides rated output, and field windings check satisfactorily, the regulator should be checked as covered under heading of "Regulator Checks."

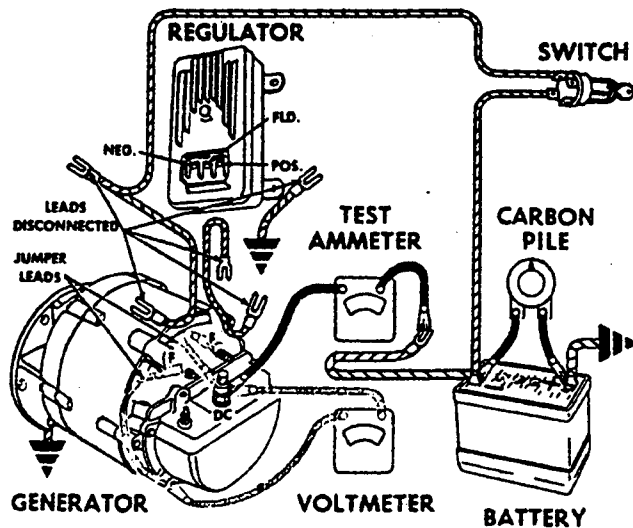


Fig. 7- Checking generator output (positive ground system).

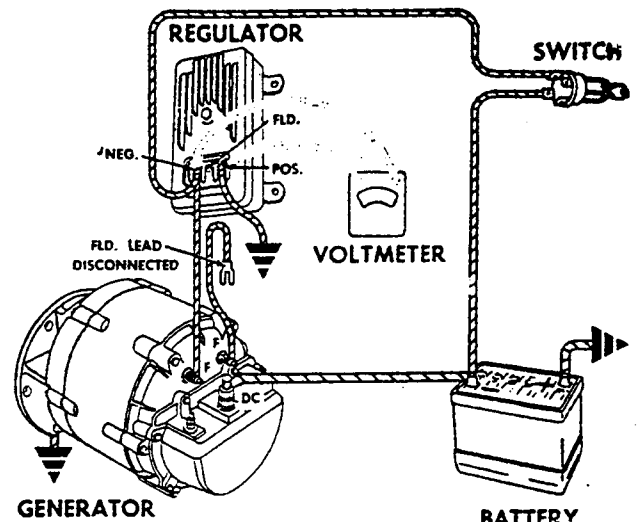


Fig. 8 - Checking generator voltage (positive ground system).

Overcharged Battery: If the voltage setting as checked above is steady and reasonably close to the specified value, lower the setting by .3 volt and check for an improved battery condition over a minimum service period of 48 hours. If the voltage cannot be adjusted to the desired value, proceed as follows:

Positive Ground System: In positive ground systems where the generator field winding is not grounded inside the generator as shown in Figure 3, the generator can be checked as follows:

1. Disconnect battery ground strap.
2. Disconnect field lead from regulator. DO NOT ALLOW LEAD TO TOUCH GROUND.
3. Connect a voltmeter across the "Pos" and "Neg" terminals on the regulator. See Figure 8.
4. Reconnect the battery ground strap.
5. Close the switch, but do not operate the generator, and observe the voltmeter reading.

## VOLTAGE REGULATION

6. Operate the engine at approximately 1000 R.P.M. (about 2300 generator R.P.M.) and observe voltmeter reading. If voltage increases, check the generator.
7. If voltage does not increase, check the regulator as covered under heading of "Regulator Checks."

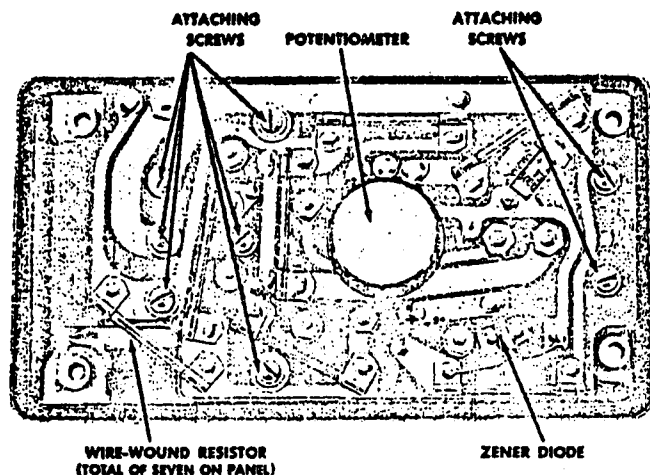


Figure 9 - Printed circuit panel board mounted on regulator cover.

### Regulator Checks

Before making electrical checks, visually inspect the wire-wound resistors (fig. 9) for opens, and make sure all soldered connections are secure. Various electrical checks with an ohmmeter can be made to determine which components are defective. The component parts are identified in Figures 9 and 10.

The ohmmeter must be accurate, and must be one which uses a 1-1/2 volt dry cell. Also, the ohmmeter polarity must be determined by connecting its leads to voltmeter leads. The voltmeter will read up-scale when the negative leads are connected together and the positive leads are connected together. The polarity of the voltmeter leads can be determined by connecting its leads to the identified terminals of a battery.

When making checks, note carefully in the illustrations how the ohmmeter is connected with regards to polarity, and select a scale such that the 10 ohm reading is at or near mid-scale. In general, the 10 ohm reading should be within, or very nearly within, the middle third of the scale.

It is important that the following checks be made in the order listed. If a defective part is found, replace it before proceeding with the remaining checks. Be sure to make all the checks as more than one component may be defective.

A defective part may be replaced by removing any attaching screws involved and unsoldering the connections. To replace the parts identified in Figure 10, separate the printed circuit board from the cover by removing the eight attaching screws shown in Figure 9. When resoldering, limit solder time to a minimum as excessive heat may damage the printed circuit and component parts. However, good soldered connections are essential for satisfactory operation. A rosin core 63% tin 37% lead



## VOLTAGE REGULATION

solder with 360° F melting point is recommended along with a soldering iron rated at 50 watts or less. Use extreme care to avoid overheating.

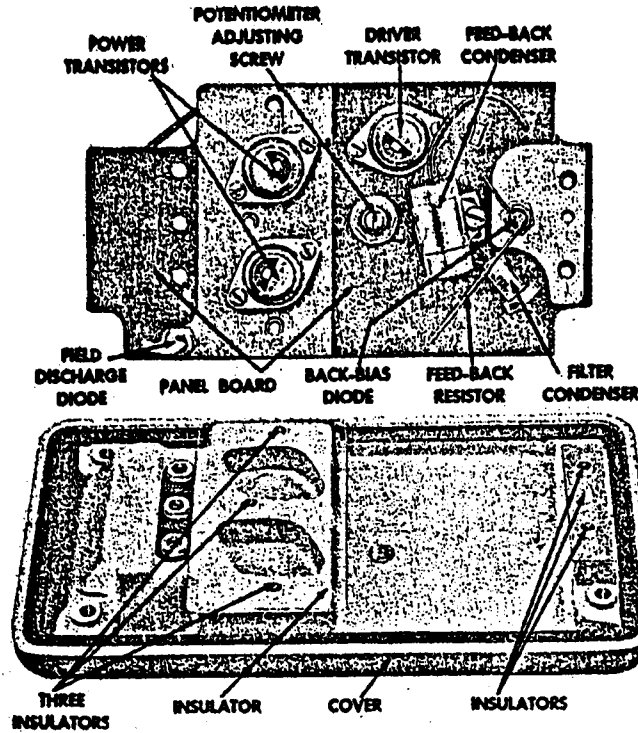


Figure 10 - Underneath side of panel board removed from regulator cover.

**Zener Diode:** To check the zener diode (fig. 9) unsolder the connection and lift the lead up just enough to separate the lead from the printed circuit. Bending the lead too far may cause it to break off inside the diode. Then connect the ohmmeter leads as shown in Part "A" of Figure 11. If the reading is zero, the diode is shorted. If the reading is very high (infinite) the diode is open. Resolder the diode lead before proceeding.

**Potentiometer:** If either reading is 100 ohms or above with the ohmmeter connected as shown in Step 1 and Step 2 in Figure 11, the potentiometer (Fig. 9) is open.

**Filter Condenser:** To check the filter condenser (Fig. 10) connect the ohmmeter as shown in Part "B" in Figure 11. A zero reading indicates a shorted filter condenser. To check for opens, inspect the two soldered connections.

**Feed-Back Condenser:** A shorted feed-back condenser (Fig. 10) will give a zero reading with the ohmmeter connected as illustrated in Part "C" in Figure 11. To determine if the condenser lead is open, carefully inspect the condenser lead at the soldered connection.

**Field Discharge Diode:** The field discharge diode (Fig. 10) is shorted if a zero reading is obtained with the ohmmeter connected as illustrated in Part "D" in Figure 11. If the reading is very high (infinite), the diode is open. Note that the diode lead has been unsoldered, and that the ohmmeter is connected to the diode lead and to the

## VOLTAGE REGULATION

attaching nut. Resolder the diode lead before proceeding with other checks.

Back Bias Diode: Check the back bias diode (Fig. 10) by connecting the ohmmeter as shown in Part "A" in Figure 12. A zero reading indicates a shorted diode, and a reading over 100 ohms indicates an open diode.

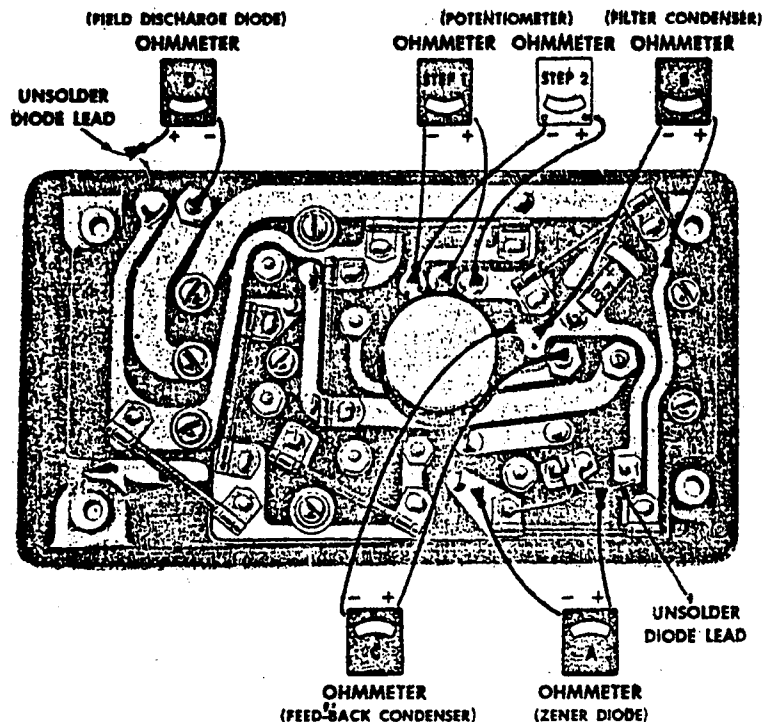


Figure 11 - Ohmmeter checks of component parts.

Shorted Power Transistor: Check the power transistors (Fig. 10) by connecting the ohmmeter the three ways shown in Figure 12. If any reading is zero ohms, one of the power transistors is shorted. To determine which power transistor is shorted, or if both transistors are shorted, remove the upper transistor (Fig. 10) and repeat the check as shown in Figure 12 on the transistor which is still mounted on the printed circuit board. If any of the three readings is zero, the transistor is shorted. Also check the transistor which has been removed by connecting the ohmmeter the three ways shown in Figure 13. A zero reading in any one of the three checks indicates a shorted transistor.

Shorted Driver Transistor: The driver transistor (Fig. 10) is shorted if any reading is zero with the ohmmeter connected the three ways shown in Figure 12.)

Open Transistors: The power transistors (Fig. 10) and the driver transistor (Fig. 10) may be checked for opens by removing the transistors from the panel board and connecting the ohmmeter to each as shown in Figure 14. A very high (infinite) reading in either check indicates an open transistor.

When attaching the panel board to the cover, note the location of the insulators as shown in Figure 10. Also, visually re-check all soldered connections and the wire-wound resistors for opens.

# VOLTAGE REGULATION

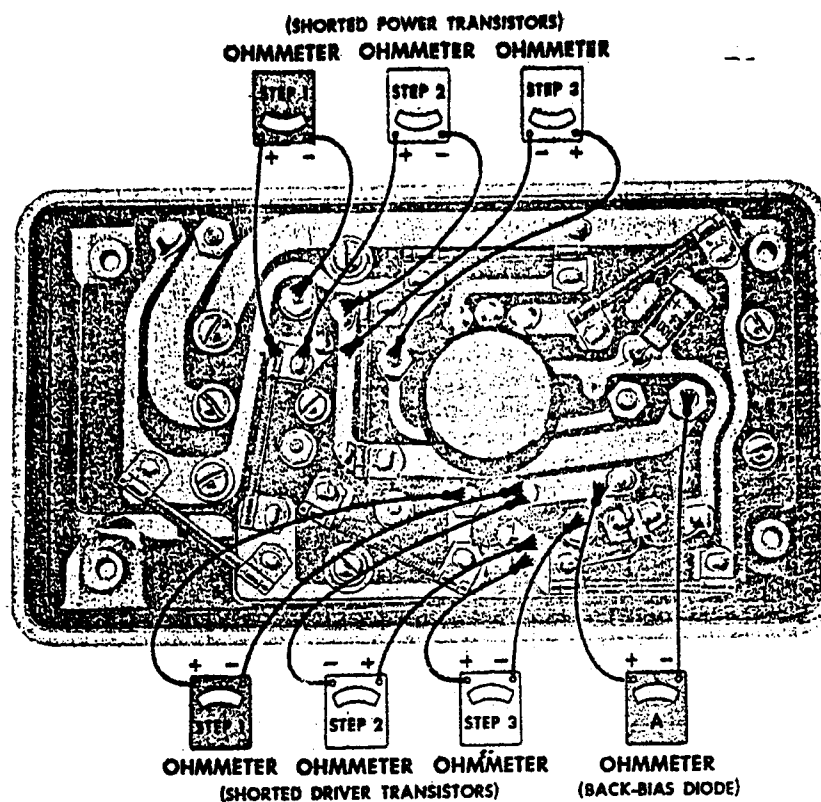


Figure 12 - Ohmmeter checks of component parts

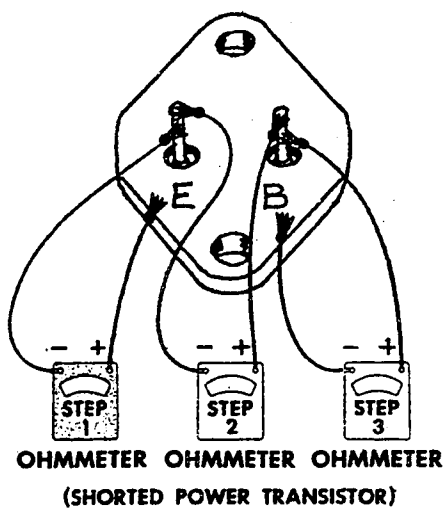


Figure 13  
Checking transistors for shorts

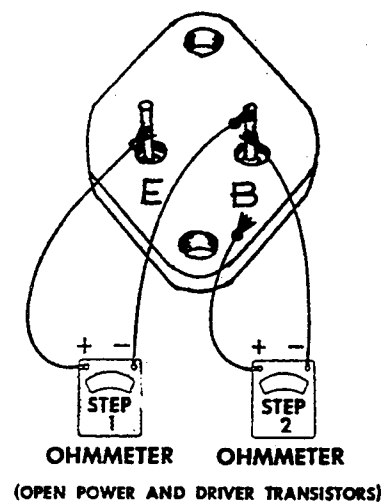


Figure 14  
Checking transistors for open

## POWER PLANT REPLACEMENT

For information not used herein, refer to Maintenance Manual X-5822 for Model PD-4501

Sec. 8A Pages 1 thru 8

Information is not applicable.

Use the following:

Power plant including engine, clutch, and transmission is mounted on engine cradle and is installed at rear of vehicle.

Engine is supported by four cushion type mountings. Clutch housing is bolted to engine and the complete power plant including exhaust system, and rear bumper is supported on cradle. In addition, one torsional stabilizer rod anchors the engine in position on cradle.

Brackets at lower edge of bulkhead support the front of cradle, while rear is supported by three hanger assemblies suspended from rear of coach body. Instructions which follow describe method of replacing the complete power plant assembly. A special dolly must be used to support power plant at cradle, and provide a means for moving assembly out of engine compartment.

### POWER PLANT REMOVAL

1. Drain cooling system, referring to COOLING SYSTEM for draining procedure.

NOTE: Before proceeding with removal operations, disconnect battery cables and exhaust air from air system at tank located forward of left rear wheel.

2. Open radiator closure door and closure door at right side of engine compartment.
3. Raise rear door.
4. Disconnect air line between engine stop and fast idle solenoids and engine governor.
5. Disconnect accelerator control cable from governor.
6. Disconnect oil line to pressure manifold at generator.
7. Disconnect two fuel lines at junction bracket on engine. Tag each line so that it can be reinstalled in the original location.
8. Disconnect air compressor expeller valve and governor discharge lines.
9. Disconnect two power steering fluid lines. Seal all openings to prevent entry of dirt. Tag each line so that they can be reinstalled in their original location.
10. Disconnect blower air intake hose from air chamber.
11. Disconnect four heater lines by loosening hose clamps.
12. Disconnect two transmission control rods from levers on transmission control cover.
13. Disconnect clutch control rod from clutch operating lever.
14. Disconnect wiring by separating two halves of two amphenol plugs.
15. Disconnect propeller shaft at slip joint by loosening dust cap.
16. Disconnect generator cable from junction on engine bulkhead.

## POWER PLANT REPLACEMENT

17. Disconnect starter cable from junction on engine bulkhead.--
18. Disconnect ground strap from transmission or body junction.
19. Remove speedometer sending unit (to clear engine bulkhead).
20. Position engine dolly under cradle and adjust to take weight off support hangers, then remove bolts at upper end of each support hanger and remove bolts from cradle brackets. Move power plant away from engine compartment slowly, meanwhile checking as necessary to see that all lines, wiring, and controls are disconnected.
21. Transmission assembly may be removed by following instructions in TRANSMISSION SECTION of this manual. Diesel engine may be lifted off cradle using lifting brackets provided at cylinder head.

### ENGINE CRADLE AND MOUNTING INSPECTION

1. Inspect cradle members and engine front support members for wear and possible fractures. Repair or replace as necessary.
2. Check condition of bulkhead brackets and bolts. Replace as necessary.

### ENGINE MOUNTINGS

1. Inspect engine front mounting bushings. If bushings are deteriorated or damaged, replace bushings.
2. Inspect engine rear mounting assemblies and engine stabilizer rod. If mountings are oil-soaked or show evidence of failure, replace mountings.

### INSTALLING POWER PLANT

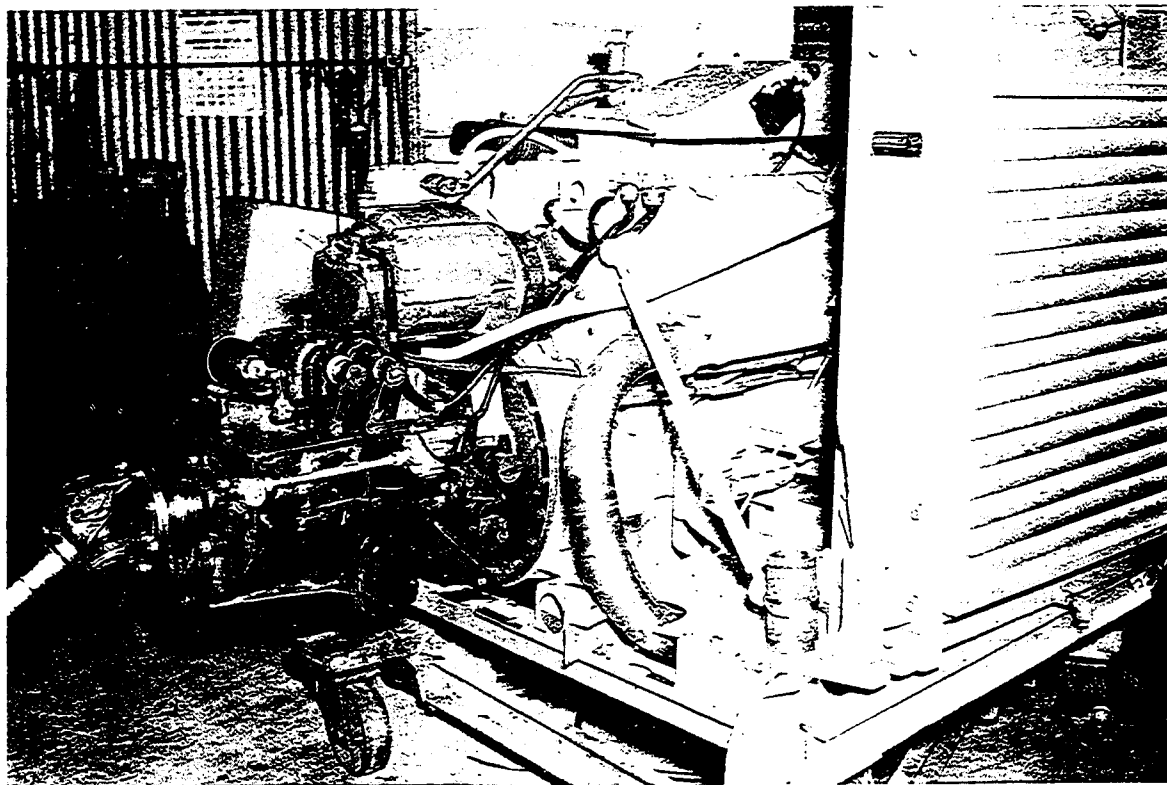
Make necessary repairs to exhaust system units before installing power plant. Clutch and transmission assembly should be assembled to engine, since attaching parts are readily accessible with power plant removed. Refer to applicable section in this manual for details and procedure for installing engine accessories.

The steps listed below should be followed in the order given to install power plant.

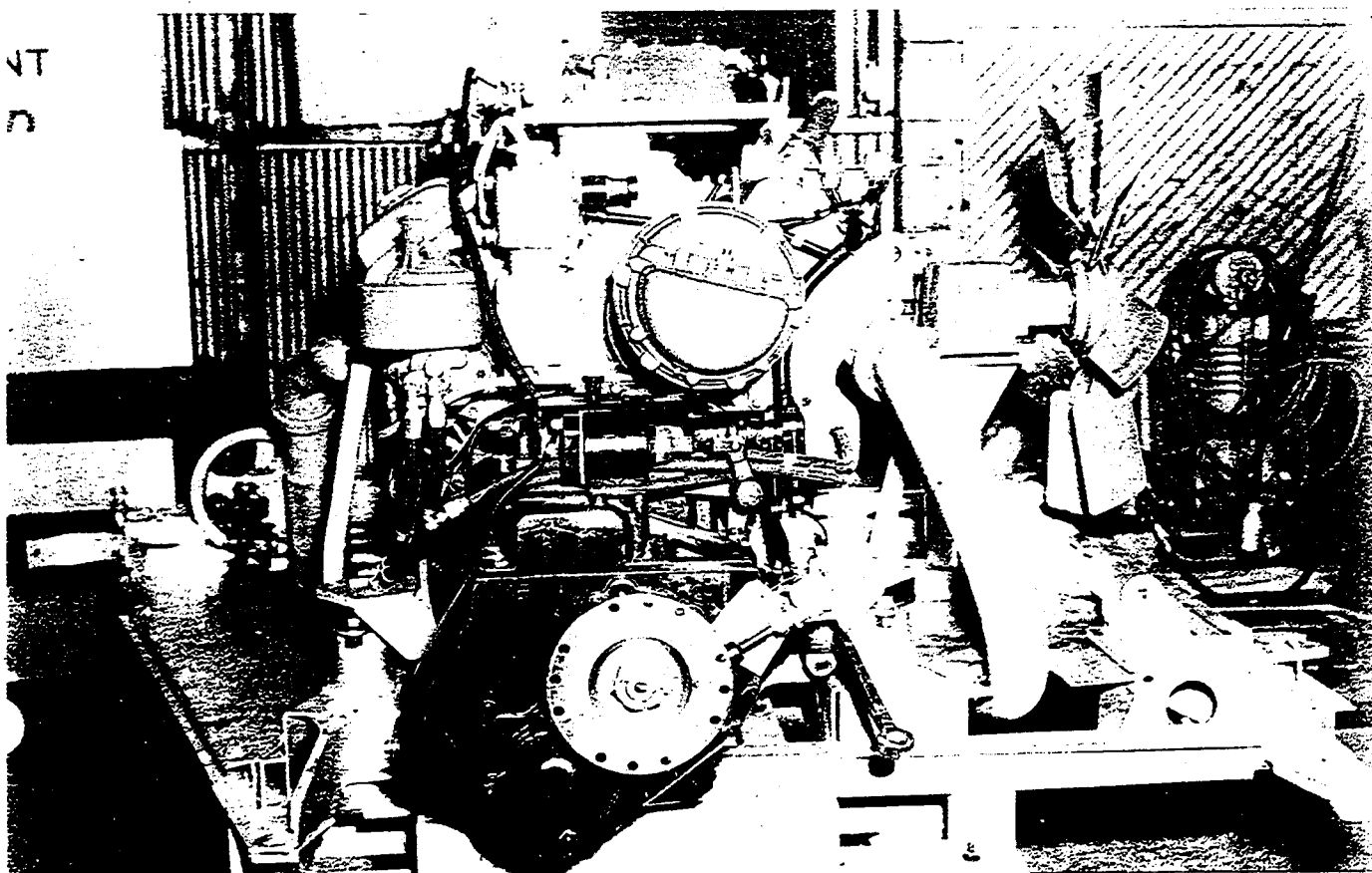
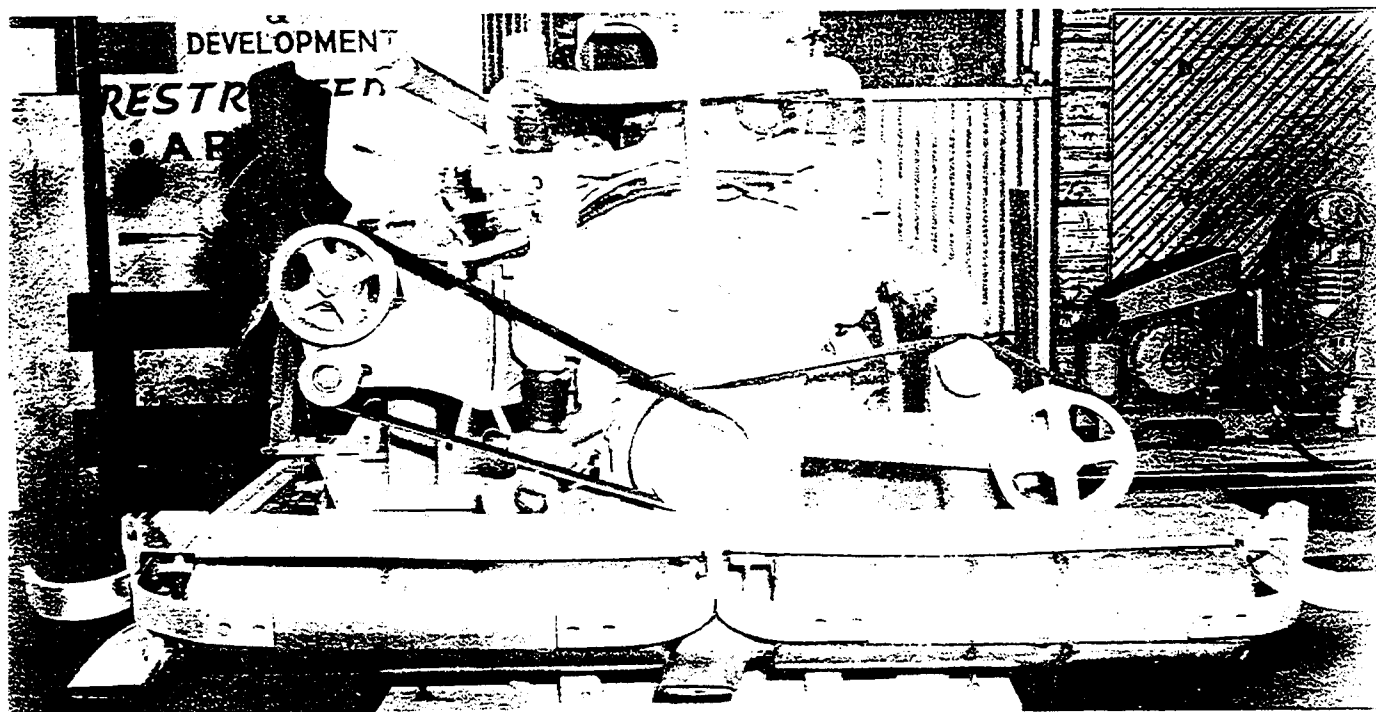
1. Move power plant assembly into position with propeller shaft splines engaged and with cradle engaging brackets. Install bolts with nuts at bulkhead brackets.
2. Install support hangers and connect at brackets. Tighten all bolts including those at bulkhead brackets firmly.
3. Remove dolly from cradle.
4. Connect air lines between engine stop and fast idle solenoids and respective cylinder assemblies on engine governor.
5. Connect accelerator control cable at governor operating bellcrank.
6. Connect generator to pressure manifold oil line.
7. Connect two fuel lines at junction bracket on engine. Be sure they are installed in their original location.
8. Connect air compressor and governor discharge lines.
9. Install speedometer sending unit.

## POWER PLANT REPLACEMENT

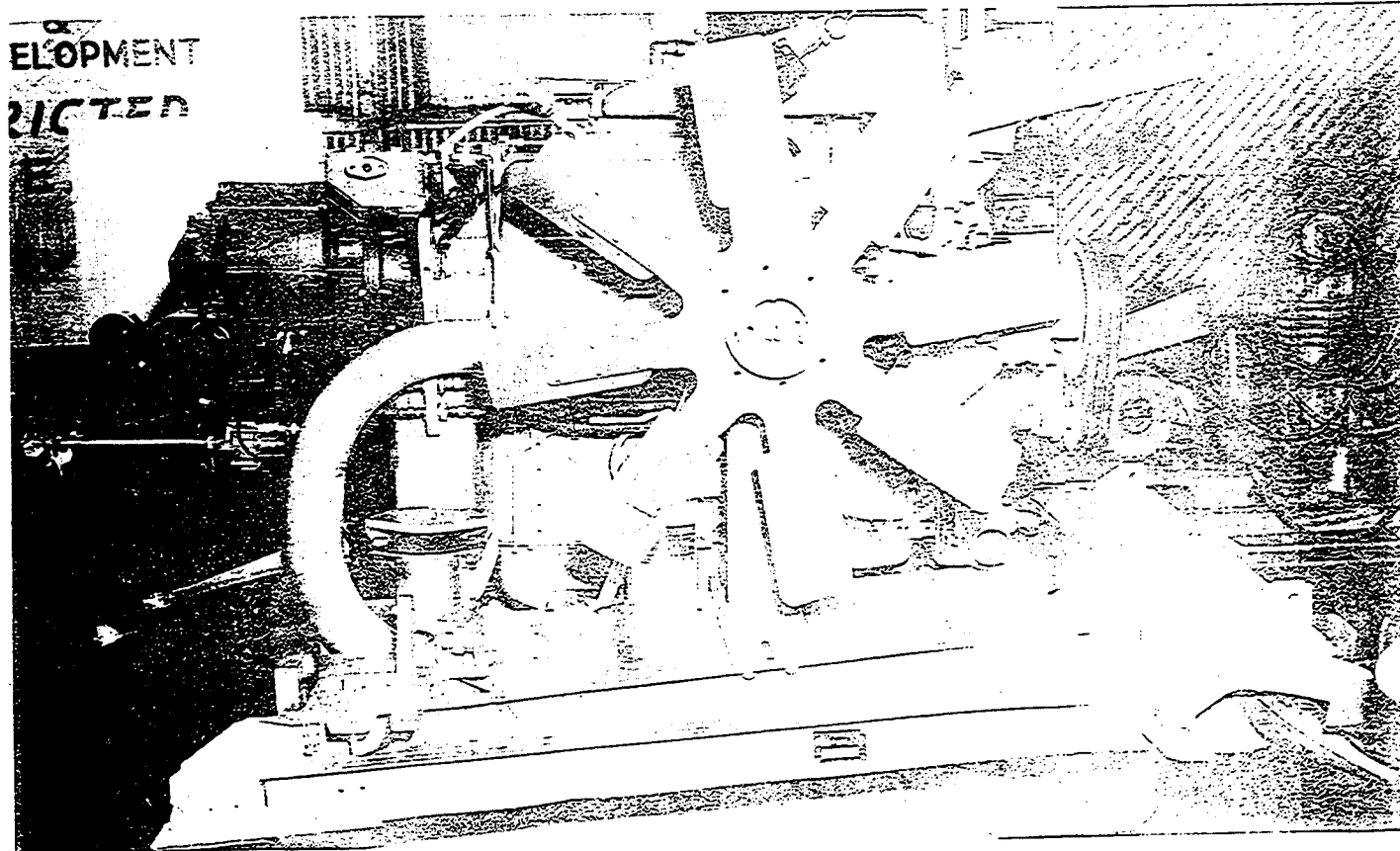
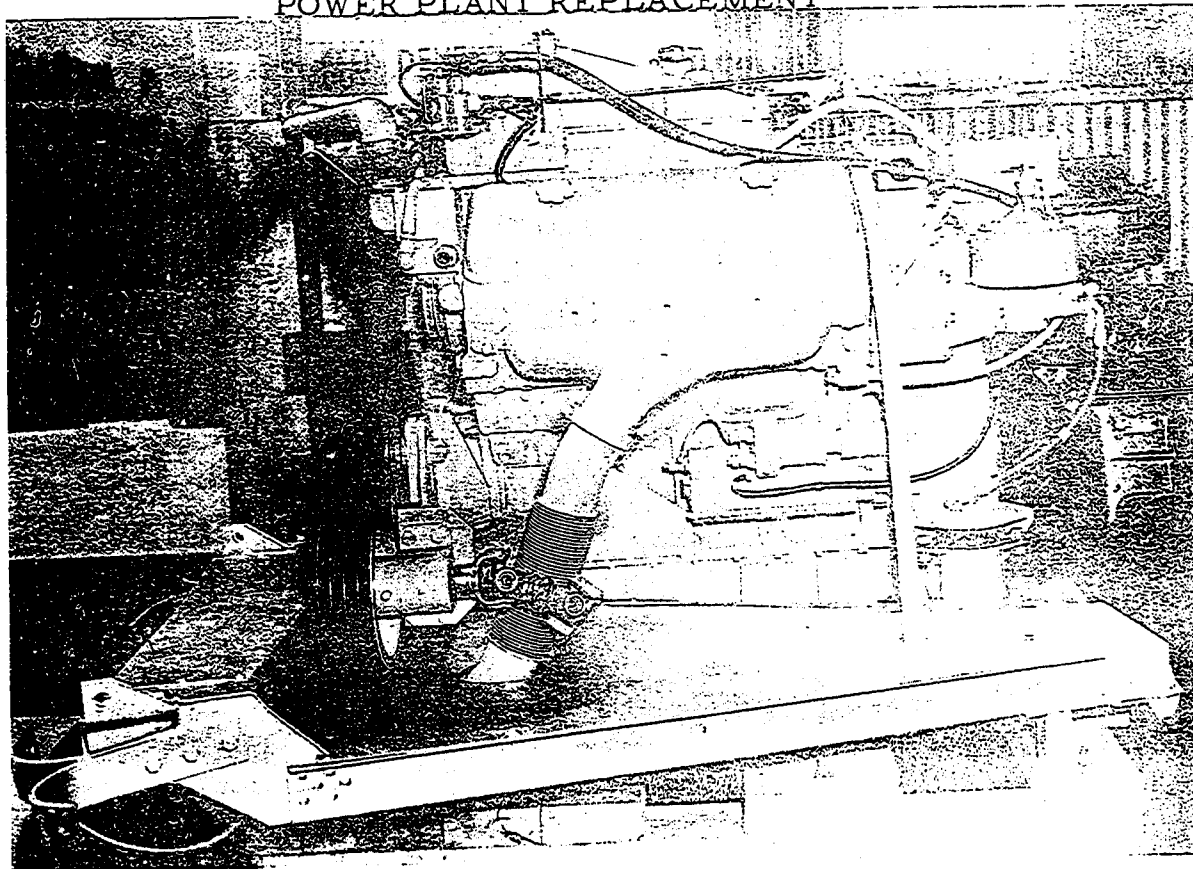
10. Connect two power steering fluid lines at junction bracket on engine. Be sure they are installed in their original location.
11. Connect blower intake hose to body air intake compartment.
12. Connect two heater lines to engine.
13. Connect two transmission control rods to levers on transmission control cover.
14. Connect clutch rod to clutch operating lever.
15. Connect air line to clutch operating cylinder.
16. Connect speedometer cable to transmission.
17. Connect wiring by connecting two halves of amphenol plugs.
18. Connect generator cable to terminal on engine bulkhead.
19. Connect starter cables to engine bulkhead.
20. Connect ground strap from transmission to body junction.
21. Fill cooling system as instructed in COOLING SYSTEM.
22. Start engine and run at fast idle until at operating temperature. During warm-up check for water and oil leaks.
23. Install and close engine compartment doors.



# POWER PLANT REPLACEMENT



# POWER PLANT REPLACEMENT





## FUEL SYSTEM

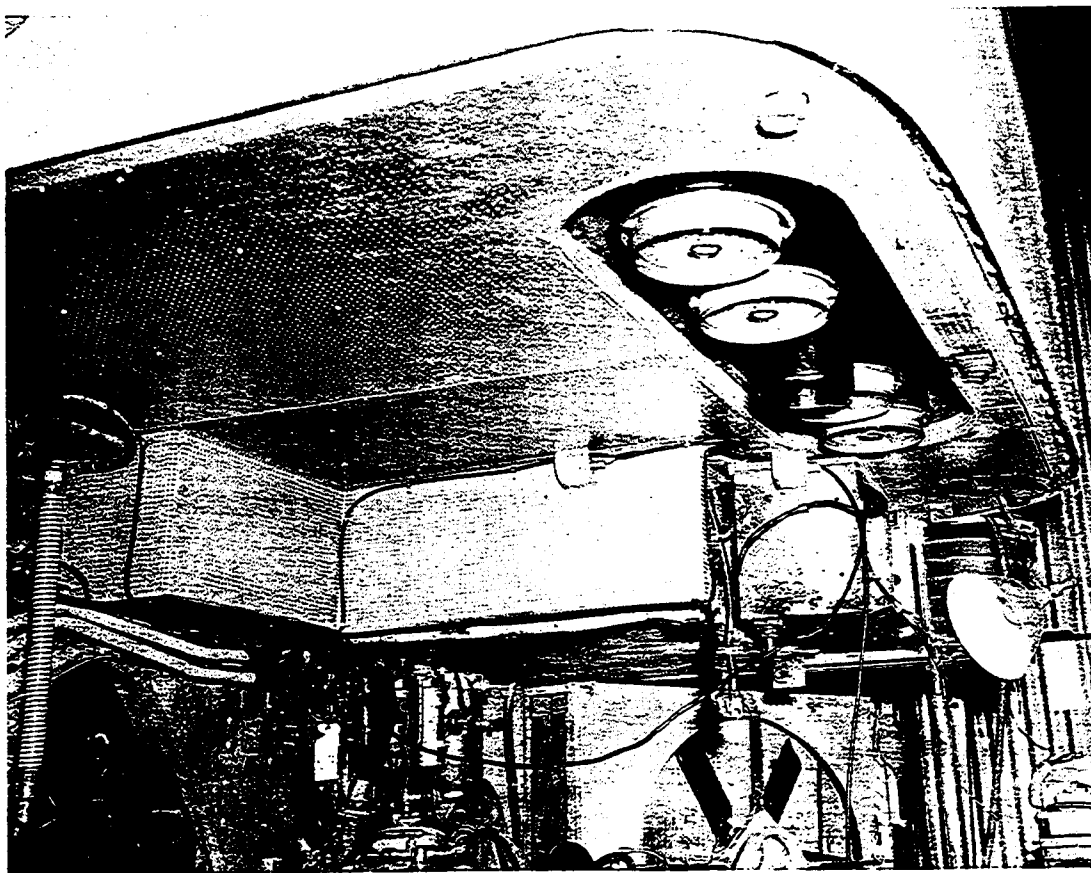
For information not listed herein, refer to Maintenance Manual X-5822 for Model PD-4501

Sec. 12 Pages 1 thru 16

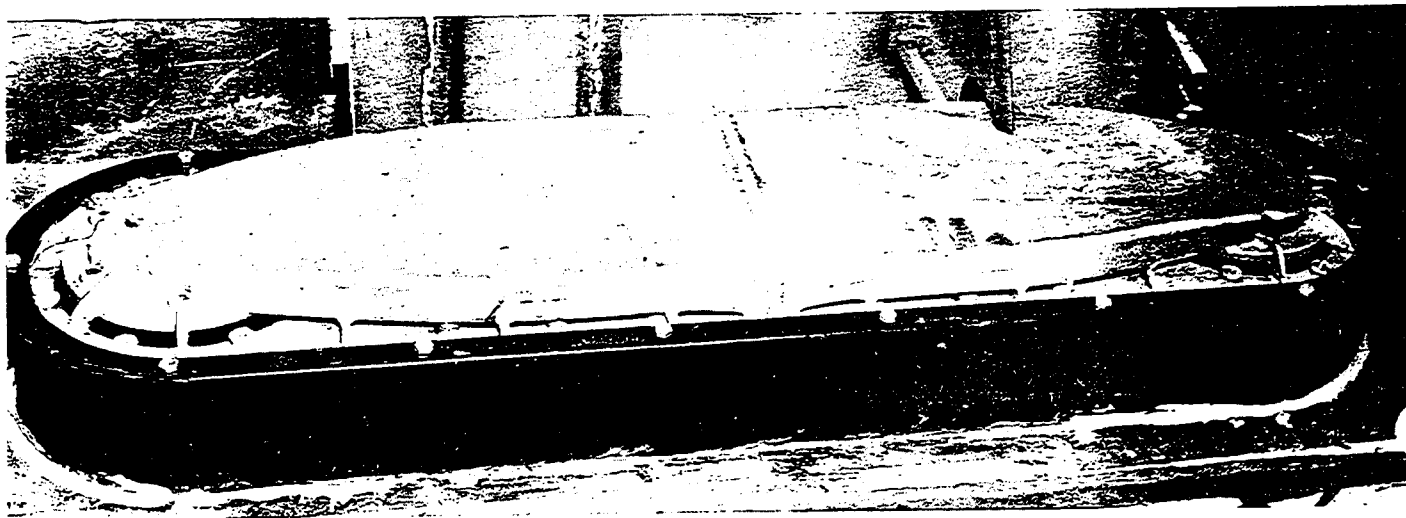
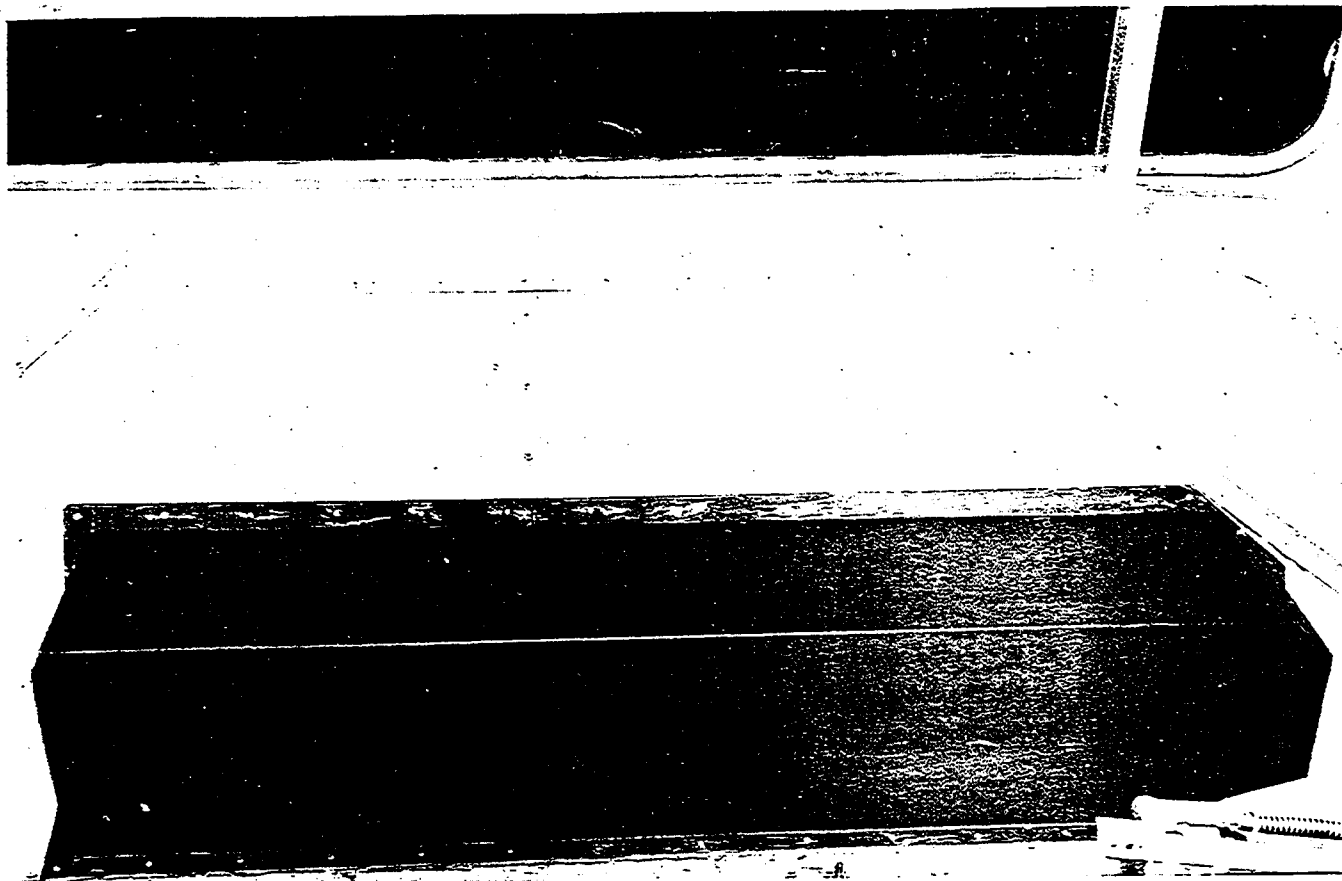
Use information as outlined below:

For operating procedures, maintenance, and specifications (except accelerator linkage) refer to Maintenance Manual X-6114 for Model PD-4106.

Use Accelerator Linkage from PD-4501 Manual X-5822 but bear in mind only one engine is used. In addition to this information, an over-run connection has been installed between cross shaft and engine governor. This over-run prohibits any further accelerator action while the fast idle solenoid is engaged.



# FUEL SYSTEM



For information not listed herein, refer to maintenance manual X-5822 for Model  
PD-4501

## LUBRICATION CHART

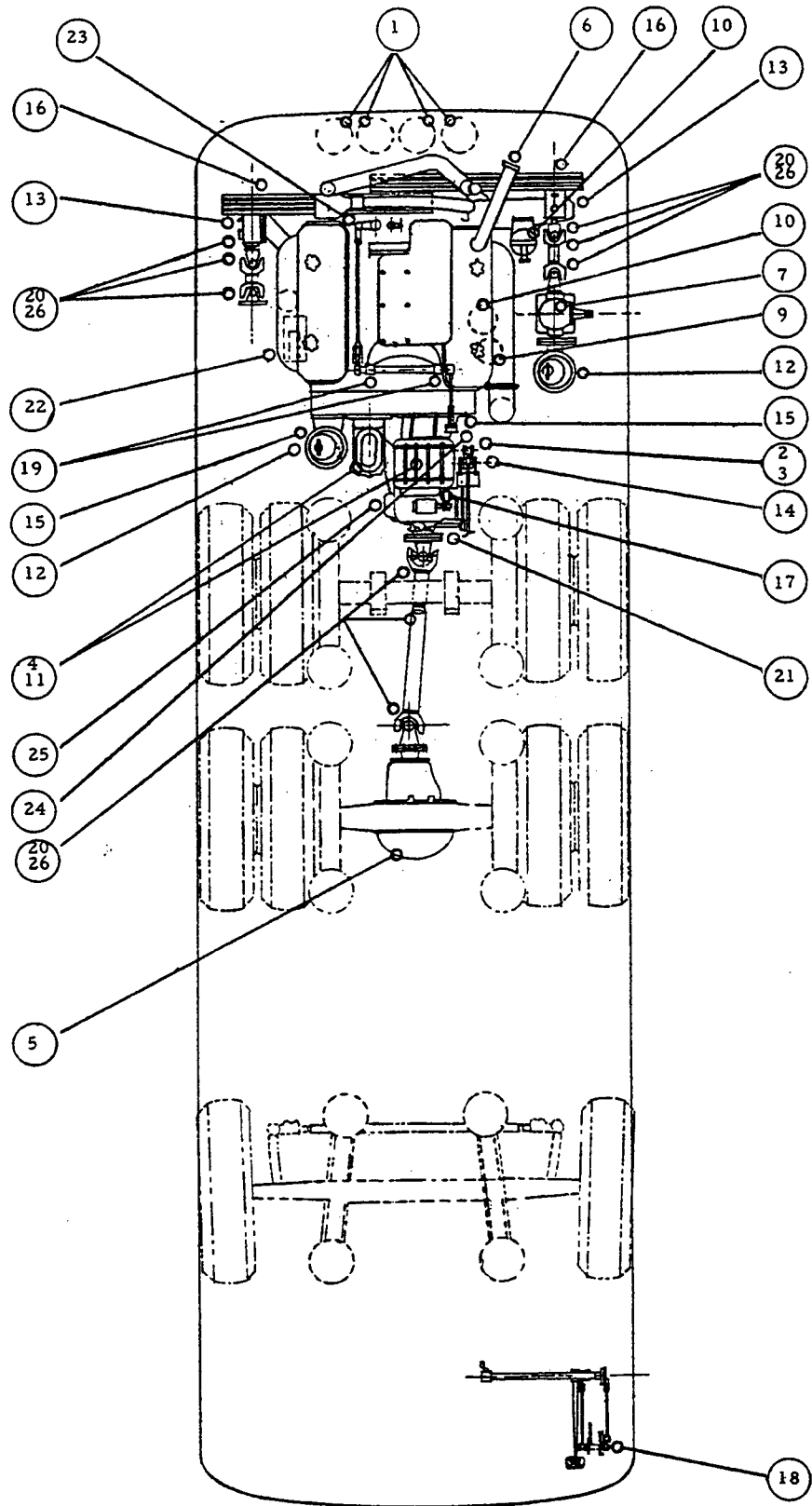
Marmon-Herrington Repowering Kit

Model PD-4501

Item No.	Item	Method	Interval	Code *
1	Air Cleaners	Keep to Level Mark	2,500	E
2	Air Cylinder (Clutch)	Pipe Plug	10,000	E
3	Air Valve (Clutch)	Thru Oiler	10,000	E
4	Compressor	Engine Crankcase	10,000	E
5	Differential, Rear Axle	Check at Level Plug	1,500	MP
		Drain and Refill	15,000	MP
6	Engine	Filler Pipe	10,000	E
		Check Daily		
7	Fan Gear Box	Check Daily	10,000	MP
8	Filter, Engine Oil	Change	5,000	E
9	Filter, Power Steering	Replace	2,500	S19
10	Fuel Oil Strainer	Clean	4,000	E
11	Generator	Engine Crankcase	10,000	E
12	Power Steering Pump	Keep to Full Mark	1,500	S19
13	Pillow Block (Fan & FREON Drive)	Pressure Fitting	5,000	C
14	Shaft, Clutch Cross (Air Assist)	Pressure Fitting	1,500	C
15	Shaft, Clutch Release	Pressure Fitting	1,500	C
16	Shaft, Idler (Fan & FREON Drive)	Pressure Fitting	1,500	C
17	Shaft, Reverse Shift Solenoid	Pressure Fitting	1,500	C
18	Shaft, Throttle Front Cross	Pressure Fitting	1,500	C
19	Shaft, Throttle Cross (At Engine)	Pressure Fitting	1,500	C
20	Slip Joint, Prop. Shaft	Pressure Fitting	1,500	C
21	Speedometer Drive (At Trans.)	Pressure Fitting	10,000	C
22	Starter	Slot Head Plug	3,000	E
23	Swivel Joint, Throttle Linkage (At Eng.)	Pressure Fitting	1,500	C
24	Throw out Bearing	Grease Cup	1,500	S2
25	Transmission	Check Level at 2000 M	12,000	E
26	Universal Joint (FREON, Fan & Main Drive)	Pressure Fitting	1,500	C

\* Code column is same as symbol column on page 3  
section 13 of Maintenance Manual X-5822.

# LUBRICATION



## STEERING SYSTEM

For information not listed herein, refer to Maintenance Manual X-5822 for Model PD-4501

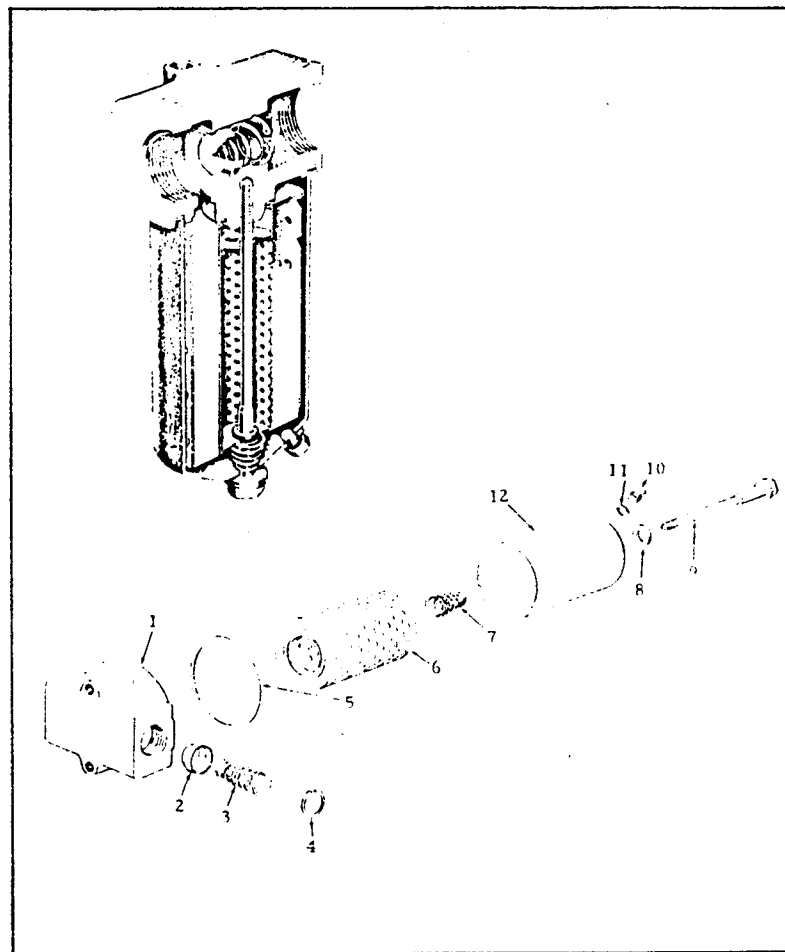
Sec. 16 Pages 1 thru 32

Information is applicable as outlined below:

The hydraulic power steering pump as furnished by Marmon-Herrington Company, Inc., is a right-hand rotation. The Model number is VT36-100-40-95-40-10-S3 R.H. with a capacity of four gallons per minute at 1200 RPM and 100 P. S. I.

For all maintenance and specification information for the steering pump, see Section 16 of Maintenance Manual X-6114 for Model PD-4106.

The original fluid filter remains unchanged. A Second fluid filter has been added in the system. An exploded view of this new filter is shown below.



- |           |              |           |            |
|-----------|--------------|-----------|------------|
| 1. Base   | 4. Snap Ring | 7. Spring | 10. Plug   |
| 2. Poppet | 5. Seal Ring | 8. Gasket | 11. Gasket |
| 3. Spring | 6. Cartridge | 9. Bolt   | 12. Body   |

## TRANSMISSION AND CONTROLS

For information not listed herein, refer to Maintenance Manual X-5822 for Model  
PD-4501

Sec. 17 Pages 1 thru 16

Information is not applicable.

Add:

TROUBLESHOOTING

<u>Cause</u>	<u>Remedy</u>
<u>Noisy Transmission</u>	
Gears worn and pitted due to lugging engine with transmission in too high a gear range.	Replace gears.
Bearing worn due to lugging engine with transmission in too high a gear range, or to chips and dirt in oil.	Replace worn and rough bearings.
Gears on mainshaft having excessive end play.	Replace worn parts.
Transmission not lined up properly with engine and drive shaft.	Check alignment of transmission with drive line and rear axle.
<u>Jumping out of Gear</u>	
Shift rail poppet springs broken.	Replace poppet spring.
Shift rail poppet notch worn.	Replace shift rail.
Shift forks sprung or loose on shift rail.	Replace sprung fork or tighten set screw in shift fork.
Gear teeth worn.	Replace worn gears.
Gears not shifting fully into mesh.	Check shift rail to make sure spacers are not assembled in wrong position.
Transmission bell housing and engine flywheel housing not lined up properly.	Remove transmission and check engine flywheel housing for alignment and squareness with engine flywheel.

## TRANSMISSION AND CONTROLS

TROUBLESHOOTING (cont.)Jumping out of Gear (cont.)

Excessive end play in mainshaft

Check washer, speedometer gear or speedometer spacer. Tighten Rear Mainshaft Nut.

Oil Leakage

Transmission overfilled.

Drain to proper level.

Breather stopped up.

Clean breather assembly.

Use of transmission oil that foams and expands when hot.

Drain and refill with high grade, properly refined, straight run mineral oil.

Drain back holes between bearing caps and main case stopped up.

Check drain holes and gaskets to make sure openings are clean.

Too much clearance between mainshaft and bearing cap oil screw-back.

Check clearance between shaft and bearing cap. Allowable clearance .010" to .015". Replace bearing cap if worn or damaged screw-back.

Broken gaskets.

Replace gaskets and use gasket cement.

ADJUSTMENTS

No adjustments are required other than those covered in Troubleshooting, Assembly and Specifications. These are not periodic or wear adjustments but those required in rebuilding or repairing.

DISASSEMBLYRemove the plug and drain lubricant from the transmissionDisassembly of shift lever and shift lever housing from shift cover

Remove reverse plunger spring retainer from side of shift cover.

Remove reverse plunger spring and lock out plunger.

Remove cap screws and lockwashers from shift lever housing.

Remove shift lever and housing from shift cover by lifting straight up.

Disassembly of shift lever and shift housing

Remove shift lever handle or ball from top of shift lever.

Remove rubber boot by sliding up off of shift lever.

## TRANSMISSION AND CONTROLS

### DISASSEMBLY (cont.)

#### Disassembly of shift lever and shift housing (cont.)

Hold down on compression cup spring collar and tap pin out of shift lever.  
 Remove compression cup, spring and collar up off of shift lever.  
 Remove rocker shaft lock ring from groove in shift lever housing.  
 Tap shift lever rocker shaft out of shift lever housing.  
 Remove shift lever from housing.

#### Disassembly of shift cover and shift forks from main transmission

Shift transmission into reverse gear.  
 Remove cap screws and lockwashers from around top of shift cover.  
 Remove shift cover and shift fork assembly from transmission by lifting it up off of transmission.

#### Disassembly of shift cover and shift forks

Place shift cover and shift fork assembly up side down in vice.  
 Remove interlock cross hole plug.  
 Remove lockwire and set screws from reverse shift fork and bracket.  
 Tap reverse shift rod out through front end of shift cover which will also force out welch plug in front of shift cover.  
 Watch poppet ball when shift rod is removed as it will fly out.  
 Remove reverse shift fork and bracket from cover.  
 Remove long interlock from cross hole in side of cover.  
 Remove lockwire and set screw from third and fourth shift fork.  
 Tap third and fourth speed shift rod out front end of shift cover which will force out welch plug in front of shift cover.  
 Watch poppet ball when shift rod is removed as it will fly out.  
 Remove third and fourth shift fork from shift cover.  
 Remove small interlock pin from third and fourth shift rod.  
 Remove short interlock from cross hole in side of cover.  
 Remove lockwire and set screws from low and second speed shift fork and bracket.  
 Tap low and second speed shift rod out front end of shift cover which will force out welch plug in front of shift cover.  
 Watch poppet ball when shift rod is removed as it will fly out.  
 Remove low and second speed shift rod from cover and remove shift fork and bracket.  
 Remove the three poppet springs from holes in shift cover.  
 Remove reverse relay shift finger from side of shift cover by loosening nut on outside of cover and removing stud from cover.  
 Remove reverse lock out plunger from relay shift finger.

#### Disassembly of shaft, gears and bearings from main case

Remove mainshaft rear universal joint companion flange nut.  
 Pull universal joint companion flange from mainshaft.



## TRANSMISSION AND CONTROLS

DISASSEMBLY (cont.)

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Disassembly of shaft, gears and bearings from main case (cont.)

- Remove cap screws from mainshaft rear bearing cap.
- Remove mainshaft rear bearing cap.
- Remove speedometer drive gear or spacer from mainshaft.
- Remove mainshaft rear bearing thrust washer.
- Slide mainshaft and gear assembly as far toward rear as possible.
- Place bearing puller on mainshaft rear ball bearing and pull bearing off of mainshaft and out of rear bore of case.
- Remove clutch release yoke and clutch release shafts.
- Remove cap screws from main drive gear bearing cap.
- Place two puller bolts in holes provided in main drive gear bearing cap and pull bearing cap and main drive gear out front of main case by screwing in on puller bolts.
- Remove main drive gear pocket bearing from end of mainshaft.
- Mainshaft and gears can now be removed from main case by lifting up front end of mainshaft first and slide it forward and lift it out of main case.
- Remove countershaft rear bearing cap screws and bearing cap.
- Remove countershaft rear bearing retaining washer cap screw.
- Remove countershaft rear bearing retainer washer from rear of countershaft.
- Remove reverse idler gear shaft by placing puller T45861 in threaded hole provided in reverse idler shaft and pull shaft out of case.
- Remove reverse idler gear and sleeve and bearing assembly.
- Remove countershaft rear bearing by sliding countershaft toward rear and place bearing puller on countershaft rear bearing and pull bearing off of rear of countershaft.
- To remove countershaft assembly, slide countershaft toward rear until countershaft front bearing is out of front bore in main case.
- Lift front end of countershaft up and slide forward until rear end of countershaft clears countershaft rear bearing bore.

Disassembly of main drive gear and bearing cap

- Remove snap ring on inside of bearing cap next to main drive gear.
- Place bearing cap on arbor press and push bearing and main drive gear out of bearing cap.
- Unlock main drive gear bearing nut where it is peened to main drive gear.
- Loosen bearing nut with wrench T56086-3 Det. 1.
- Press main drive gear bearing off of main drive gear.

Disassembly of mainshaft gears and mainshaft

- Remove mainshaft third and fourth speed clutch collar from mainshaft.
- Remove mainshaft low speed gear and needle roller bearings from rear of mainshaft being careful not to lose needle bearings.
- Remove mainshaft low and second speed clutch gear from rear of mainshaft.
- Remove mainshaft third and fourth speed clutch gear snap ring from front end of mainshaft with snap ring spreaders.

## TRANSMISSION AND CONTROLS

### DISASSEMBLY (cont.)

#### Disassembly of mainshaft gears and mainshaft (cont.)

Mainshaft third and fourth speed clutch gear, mainshaft third speed gear and sleeve and mainshaft second speed gear can be removed from mainshaft by placing mainshaft and gear assembly under arbor press with rear end of mainshaft down and mainshaft second speed gear resting on bed of arbor press and press down on front end of mainshaft which will remove gears from mainshaft. Care should be taken as needle roller bearings and third speed gear sleeve lock balls will fall out when removed from mainshaft.

#### Disassembly of countershaft

Place bearing puller on countershaft front roller bearing and pull bearing off front end of countershaft.  
Remove countershaft drive gear snap ring with snap ring spreader.  
Press off countershaft gears one at a time by placing gear on bed of arbor press and pushing countershaft out of gear.

#### Disassembly of clutch bell housing from main case

Clutch bell housing does not have to be removed from main case, unless gasket between main case and bell housing leaks oil or case or bell housing is damaged and has to be replaced.  
To remove bell housing from main case, remove cap screws and lockwasher in bell housing and remove bell housing from main case.

### REPAIRS

Clean all parts in solvent and inspect. Replace parts showing excessive wear. Gaskets, oil seals, cotter pins and lockwires usually require replacement. CHECK ALL CLEARANCES AND ADJUSTMENTS USING INFORMATION GIVEN IN SPECIFICATIONS.  
Ball bearings showing flaking, spalling or scoring should be replaced. Experience will dictate the period at which bearings showing only normal wear should be replaced. Do not spin ball bearings in dry condition - damage may result.  
Check springs for loss of free height, weigh if necessary, or if any question arises, use figures given in SPECIFICATIONS.

### LUBRICATION

Use 16 pints of a pure, high grade, properly refined, straight run or blended, mineral oil. SAE 50 engine oil, or its equivalent for summer and winter use. The lubricant should contain no vegetable or animal oils, resin, soaps, graphite, fillers, or foreign material of any type. No additives designed to impart extreme pressure properties should be used.  
The addition of anti-foam and oxidation inhibiting agents are not objectionable.

## TRANSMISSION AND CONTROLS

LUBRICATION (cont.)

Fill the transmission through the filler hole (oil level hole) until the oil overflows, which is then the correct level. Every 2,000 miles, check the oil level and add lubricant if necessary.

Every 12,000 miles, the old oil should be drained and the case thoroughly flushed out and refilled with new lubricant.

ASSEMBLYClean all parts in solventAssembly of main case and bell housing

Coat front face of main case with gasket cement.

Place main case and clutch housing gasket on front of main case.

Coat gasket with gasket cement.

Place clutch housing on front of main case and line up main bearing bore with tool T43634-11 or main drive gear bearing cap, and secure housing to main case with cap screws and lockwashers.

Coat power take-off opening gaskets with gasket cement and assemble on each side of main case with P. T. O. opening covers and secure in place with cap screws and lockwashers.

Assembly of countershaft

Place countershaft second speed gear key in countershaft keyway.

Press on countershaft second speed gear with longest hub of gear to rear or with chamfered end of bore to rear.

Place countershaft third speed gear key in countershaft keyway.

Press on countershaft third speed gear with longest hub to front.

Place countershaft P. T. O. drive gear key in countershaft keyway.

Press on countershaft P. T. O. drive gear with longest hub to front.

Place countershaft drive gear key in countershaft keyway.

Press on countershaft drive gear with longest hub to rear.

Place countershaft drive gear snap ring over tool T47535-30 Det. 2 and place tool on front end of countershaft and slide snap ring down over tool and into groove provided in countershaft with tool T47535-30 Det. 1.

Press on countershaft front roller bearing.

Assembly of mainshaft gears and mainshaft

Coat inside bore of mainshaft low speed gear with heavy grease.

Place two rows of needle roller bearings (72 per row) on inside of mainshaft low speed gear with spacer between rows of needle roller bearings.

Coat inside bore of mainshaft second speed gear with heavy grease.

Place two rows of needle roller bearings (72 per row) on inside of mainshaft second speed gear with spacer between rows of needle roller bearings.

## TRANSMISSION AND CONTROLS

ASSEMBLY (cont.)Assembly of mainshaft gears and mainshaft (cont.)

Coat inside bore of mainshaft third speed gear with heavy grease.  
Place two rows of needle roller bearings (72 per row) on inside of mainshaft third speed gear with spacer between rows of needle bearings.  
Place mainshaft in vice with rear end down.  
Place mainshaft second speed gear and needle roller bearing assembly over mainshaft with clutching teeth to rear of mainshaft.  
Place mainshaft third speed gear sleeve on mainshaft with flanged end of sleeve toward rear, line up the two notches on inside of sleeve with splines of mainshaft and place two sleeve lock balls in notches of sleeve and press third speed gear sleeve on mainshaft with tool T47535-31 Det. 1, or proper size tube. Do not press on flange of sleeve.  
Place mainshaft third speed gear and needle roller bearing assembly on mainshaft sleeve with clutching teeth to front.  
Place mainshaft third and fourth speed clutch gear on front of mainshaft with hub of clutch gear to front and press in place with tool T47535-31 Det. 1 or proper size tube. This clutch gear (82-566-1) has been changed to hopping guard on load side as well as coast side when in third speed.  
Place tool T47535-30 Det. 2 on front end of mainshaft and slide third and fourth speed clutch gear snap ring over tool and press down into groove provided in mainshaft with tool T47535-30 Det. 1.  
Place third and fourth speed clutch collar on clutch gear with longest hub to the rear or toward mainshaft third speed gear.  
Remove mainshaft from vice.  
Place mainshaft low and second speed clutch gear with shift fork collar to rear, on splines of mainshaft.  
Place mainshaft low speed gear and needle roller bearing assembly on rear of mainshaft with clutching teeth to front of mainshaft.  
Grease one side of mainshaft low speed gear thrust washer and place on rear of mainshaft with greased side against low speed gear.

Assembly of main drive gear and bearing cap

Press main drive gear ball bearing on main drive gear with bearing shield toward gear.  
Assemble bearing lock nut on drive gear and tighten against ball bearing with wrench T56086-3 Det. 1.  
Lock nut by peening lock nut into two slots in stem of main drive gear.  
Place main drive gear bearing cap over main drive gear bearing and press into position.  
Insert snap ring into groove provided on inside of main drive gear bearing cap to hold bearing in bearing cap.

## TRANSMISSION AND CONTROLS

ASSEMBLY (cont.)Assembly of reverse idler gear and sleeve

Place key in keyway of reverse idler gear sleeve.  
Place reverse idler gear on sleeve and make sure it slides free.  
Place two roller bearings on inside of reverse idler gear sleeve.

Assembly of gears and shafts in main case

Place countershaft assembly in main case by lowering rear end of countershaft into case first and slide rear of countershaft through countershaft rear bearing bore and lower front end.  
Slide countershaft forward and line up front countershaft bearing with bore in case and tap rear of countershaft with soft hammer to enter bearing in case.  
Place countershaft rear ball bearing on countershaft with snap ring to rear and tap in place in case and on countershaft with tool T46242-66 or proper size tubing.  
Place small pin in hole provided in rear end of countershaft.  
Place countershaft rear bearing retaining washer on rear of countershaft and secure in place with cap screw and lockwasher.  
Place reverse idler gear and sleeve assembly in case with shift fork collar of reverse idler gear to rear of case.  
Start reverse idler gear shaft through hole provided in case and line up reverse idler gear bearings with shaft and tap shaft through bearings in sleeve and make sure flat on rear of reverse idler shaft is lined up so countershaft rear bearing cap will lock reverse idler shaft in place.  
Coat countershaft rear bearing cap gasket with gasket cement.  
Place gasket on rear of main case.  
Place countershaft rear bearing cap in place with protruding part to lock reverse idler gear shaft in proper location and secure bearing cap with cap screws and lockwashers.  
Assemble mainshaft and gears in main case by lowering rear end of mainshaft first and slide rear of mainshaft through mainshaft rear bearing bore of main case and then lower front end of mainshaft in place.  
Place main drive gear pocket bearing on front end of mainshaft.  
NOTE: Bearing 421-5207-1 (Hyatt U-5207-YM) must be assembled on shaft with snap ring in outer race to rear.  
Coat main drive gear bearing cap gasket with gasket cement and place gasket on bearing cap.  
Place main drive gear and bearing cap assembly in front mainshaft bore in case with mark TOP on bearing cap to top of case and tap in place with a soft hammer.  
Secure bearing cap in place with cap screws and lockwashers.  
Install clutch release yoke and release shaft in clutch housing and secure yoke to release shafts with key and thin head cap screws and thin lockwashers.  
Place mainshaft rear ball bearing on rear of mainshaft with snap ring on outer diameter of bearing toward rear and tap in place on mainshaft and in case bore with bearing driver T46242-66.

ASSEMBLY (cont.)Assembly of gears and shafts in main case (cont.)

Place mainshaft rear bearing thrust washer on mainshaft and slide against bearing. Place speedometer drive gear or spacer, if speedometer gear is not used on mainshaft, next to thrust washer.

Place speedometer driven gear lower bushing in rear mainshaft bearing cap and tap in place.

Install speedometer driven gear in bearing cap and secure in place with upper bushing and two cap screws and lockwashers.

Coat mainshaft rear bearing cap gasket with gasket cement and install on rear of main case and line up oil drain holes.

Install mainshaft rear bearing cap and line up oil drain holes with holes in end of main case and secure in place with cap screws and lockwashers.

Press universal joint companion flange on mainshaft with pusher T36628-2.

Secure universal joint companion flange with flat washer, nut and cotter pin.

Place clutch housing hand hole cover on lower opening of clutch housing and secure with two cap screws and lockwashers.

Coat top of main case with gasket cement.

Place shift cover and main case gasket on top of main case.

Assembly of shift cover and shift fork

Place shift cover housing in vice upside down and by standing in front of shift cover proceed as follows:

Place reverse relay shift finger stud in shift finger (NOTE: HEAD OF STUD TO BE ON SAME SIDE AS SHIFT FINGER.)

Place reverse lock out plunger in reverse relay shift finger.

Place reverse shift finger in place and tap stud through shift cover housing and secure with lockwasher and nut.

Place three shift rod poppet springs in holes provided in shift cover housing.

Slide first and second shift rod into right hand hole in front end of cover.

Install first and second shift rod bracket on shift rod.

Place poppet ball on poppet spring and hold down and slide shift rod through boss in cover.

Place first and second speed shift fork on shift rod (longest hub toward front) and slide shift rod through into place.

Line up set screw holes in shift fork and bracket with set screw positions in shift rod.

Place pointed set screws in shift fork and bracket and tighten set screws and lockwire set screws so wire does not interfere when shifting.

Place short interlock in cross hole in shift cover and slide through to first and second shift rod.

Slide third and fourth shift rod in center hole in front end of shift cover.

Place small interlock pin in shift rod.

Place third and fourth shift fork in position and slide shift rod through shift fork.

Place poppet ball on poppet spring and hold down and slide shift rod through into position.

## TRANSMISSION AND CONTROLS

ASSEMBLY (cont.)Assembly of shift cover and shift fork (cont.)

Line up set screw hole in shift fork with set screw position in shift rod.  
 Place pointed set screw in shift fork and tighten and lockwire.  
 Place long interlock in cross hole in shift cover and slide through to third and fourth shift rod.  
 Place reverse shift rod in last hole in front end of shift cover.  
 Place reverse shift rod bracket in place and slide reverse shift rod through bracket.  
 Place poppet ball on poppet spring and hold down and slide shift rod through and place reverse shift fork on shift rod (longest hub to front) and stick through into position.  
 Line up set screw holes in shift fork and bracket with set screw position in shift rod.  
 Install pointed set screws and tighten and lockwire set screws so wire does not interfere when shifting.  
 Install three shift rod hole welch plugs in front end of shift cover and expand welch plugs.  
 Install interlock cross hole plug in side of shift covers.

To check shift cover.

Shift into reverse position and then try to shift into low or second speed to make sure that interlocks lock out low and second shift rod.  
 Check each shift to make sure it shifts full into poppets.  
 To assemble shift cover on transmission, shift transmission into reverse gear and shift cover into reverse and place on top of main case making sure shift forks are in proper place in shift collars.  
 Secure shift cover and shift fork assembly to main case with cap screws and lock-washers.

Assembly of shift lever and shift lever housing

Grip lower end of shift lever in vice.  
 Place shift lever housing down over shift lever.  
 Place shift lever rocker shaft in cross hole in shift lever housing and tap through housing and line up hole in shift lever and tap through into position, making sure slot in end of rocker shaft is lined up with groove around shift lever housing.  
 Place rocker shaft lock ring in groove provided in shift lever housing.  
 Place felt ring around top of shift lever housing.  
 Slide shift lever compression cup down over shift lever and on top of shift lever housing.  
 Slide shift lever compression cup spring down over shift lever and onto compression cup.  
 Slide shift lever compression cup spring collar over shift lever and onto spring.

## TRANSMISSION AND CONTROLS

### ASSEMBLY (cont.)

#### Assembly of shift lever and shift lever housing (cont.)

Hold shift lever compression cup spring collar down and tap shift collar pin through shift lever so it locks collar into position.  
Place rubber boot down over shift lever and force down to compression cup.  
Place shift lever handle or ball on top of shift lever and tighten.

#### Assembly of shift lever and housing on shift cover.

Coat shift cover housing gasket with gasket cement and place on top of shift cover.  
Place shift lever and shift lever housing on top of shift cover, making sure lower end of shift lever is in proper location in shift brackets of shift cover.  
Secure shift lever housing with cap screws and lockwashers.  
Place reverse lockout plunger in hole provided in side of shift cover and slide through into position.  
Install reverse lockout plunger spring.  
Screw in reverse plunger spring retainer and tighten.  
Check shift to make sure it shifts full into all speeds.

### SPECIFICATIONS

To assist in rebuilding units up to original factory standards, maintenance information is given herewith.

Ball and Roller Bearing Fits on shafts and in bores are to ABEC-1 tolerances. If questions of shaft and bore size arise consult bearing book using tables for shaft revolving, housing stationary. These tables show a light press fit for the inner race and a push fit for the outer race. All ball bearings of same size use the same fits regardless of make. Roller bearings take slightly more liberal tolerances, but same type of fit.

Fits referred to by name are:

Sliding: Part should slide freely but without considerable shake.

Running: The fit should allow clearance for heat expansion plus oil film. This is a maximum of about .003" (new) clearance on average size needle bearings in large transmissions, two or three thousandths more for bronze bushing fits.

Ball and Roller Bearing sizes shown do not indicate the internal fits as regards end play or radial clearance, which in many cases are special. Optional bearings of makes other than those shown may often be used. We caution against the installation of bearings from sources other than our authorized service channels.

Changes or Substitutions may occur from time to time which alter the information given.



## TRANSMISSION AND CONTROLS

SPECIFICATIONS (cont.)BEARINGS

<u>Part Name</u>		<u>Part No.</u>
<u>GENERAL DATA</u>		
Speeds	4 forward & 1 reverse	
Make	Spicer Mfg.	
Model	8245B	
<u>GEAR RATIOS</u>		
1st	3.88 to 1	
2nd	2.29	
3rd	1.44	
4th	1.00	
Reverse	3.96	
<u>DRIVE GEAR</u>	Single Row Ball	910050
<u>MAINSHAFT</u>		
Pocket	Straight Roller	910049
Rear	Single Row Ball	910007
<u>NEEDLES - Mainshaft Gears</u>		
1st speed gear	2 Rows (72 per row)	910107
2nd speed gear	2 Rows (72 per row)	910107
3rd speed gear	2 Rows (72 per row)	910107
<u>COUNTERSHAFT</u>		
Front	Straight Roller	910031
Rear	Single Row Ball	910029
<u>REVERSE IDLER GEAR SHAFT</u>		
Front and Rear	Straight Roller	910010
<u>CLUTCH RELEASE SHAFT</u>		
Bushings	1.003" - 1.001" Ream	

CLEARANCES

Splines and Sliding Clutches  
 Countershaft Overdrive  
 Gear Bushing and Sleeve

.004" to .006"

# TRANSMISSION AND CONTROLS

## SPECIFICATIONS (cont.)

### END PLAY IN HELICAL GEARS

Low and Overdrive Sets	.010" to .016"
Other Helical Gears	.008" to .013"

### SPIRAL OIL RETURN GROOVE CLEARANCE

Mainshaft Rear Bearing Cap and Companion Flange Hub	.010" to .015"
Front Bearing Cap and Drive Gear	.010" to .015"

### PRESS FIT OF COUNTERSHAFT GEARS

All-tight by	.001" to .003"
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### END PLAY OF MAINSHAFT

New Bearing	.000" to .015"
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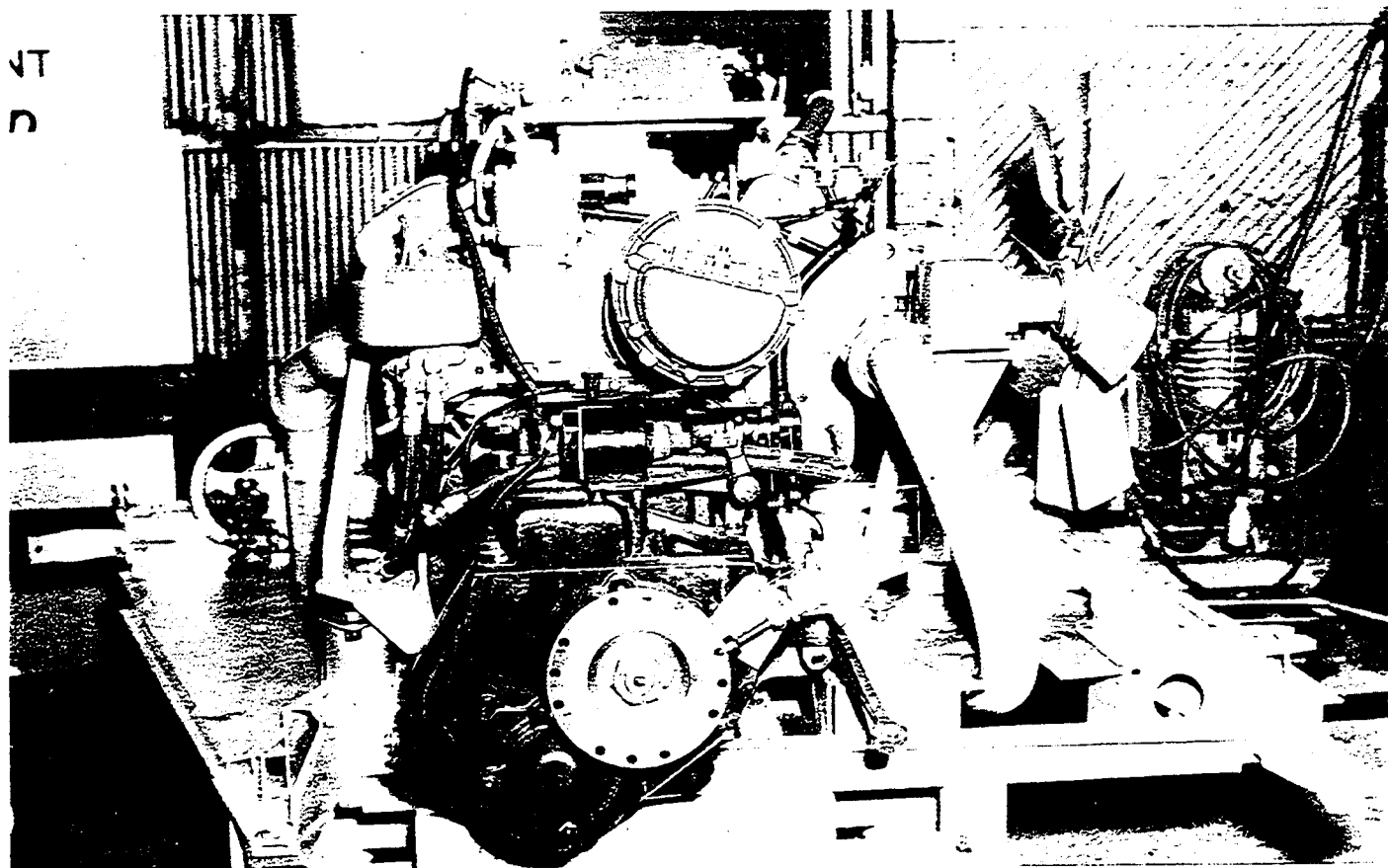
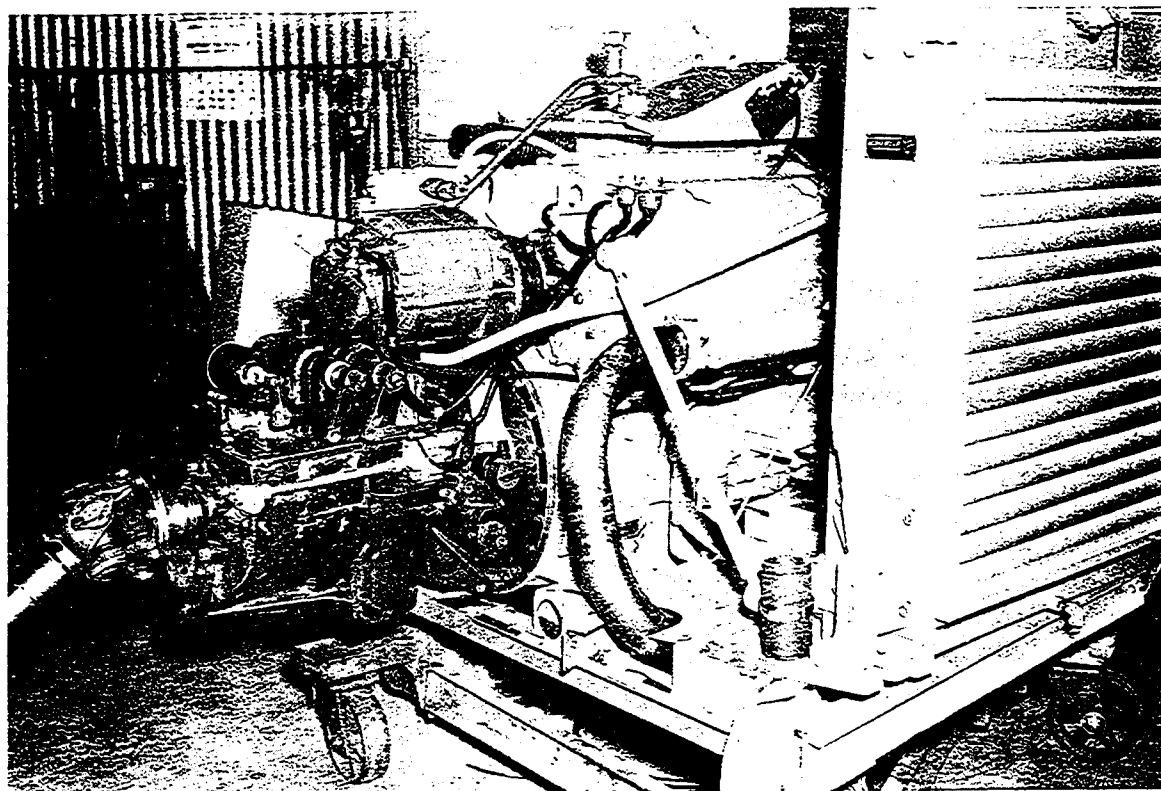
### SHIFTING

Shift Rod Poppet Spring (1st & 2nd) (3rd & 4th) (Rev.)	1-7/32"
Free Height	40# - 36#
Lbs. Press @ 1" Height	

### REVERSE LOCKOUT SPRING

Free Height	2-1/32"
Lbs. Pressure @ 1-5/8" Height	60#

TRANSMISSION AND CONTROLS



## PROPELLER SHAFT

For information not listed herein, refer to Maintenance Manual X-5822 for Model PD-4501

Sec. 18 Pages 1 thru 4

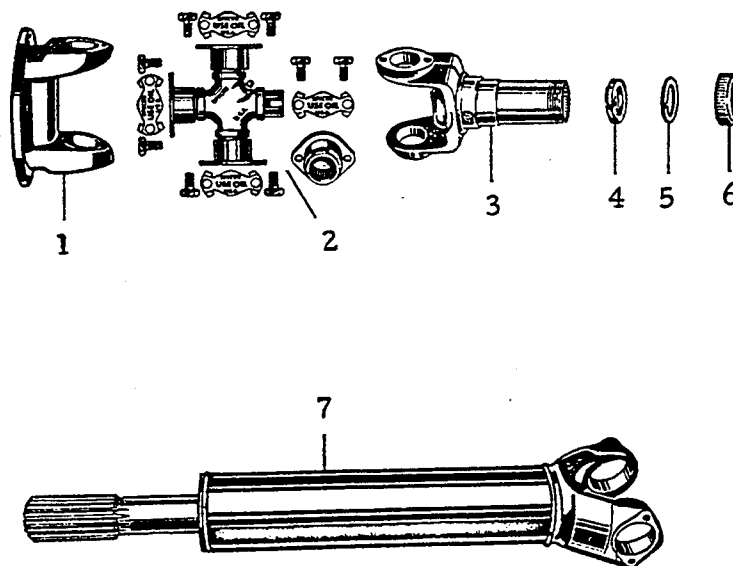
Information is not applicable.

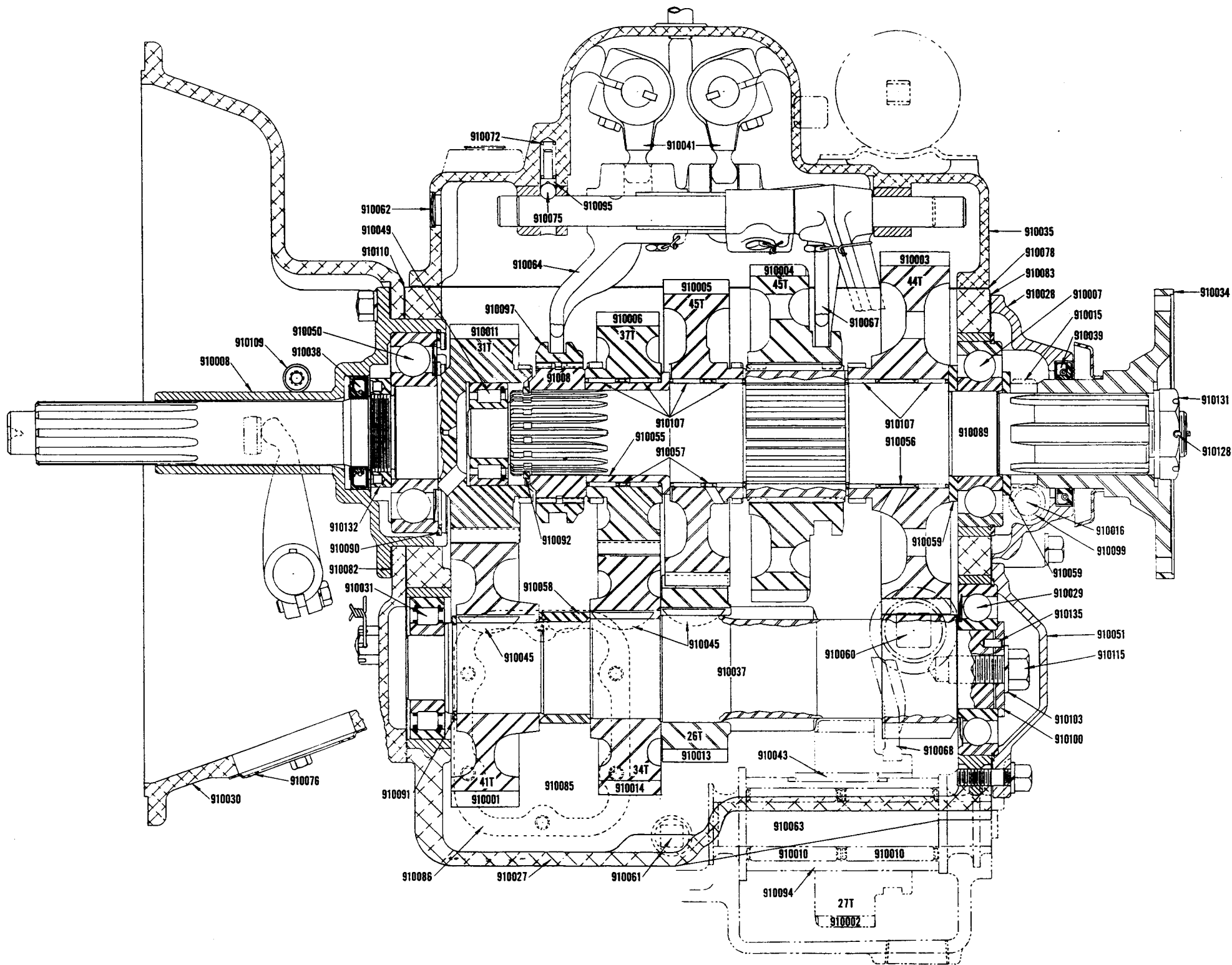
All maintenance information in Maintenance Manual X-6114 for Model PD-4106 is applicable with the following exceptions:

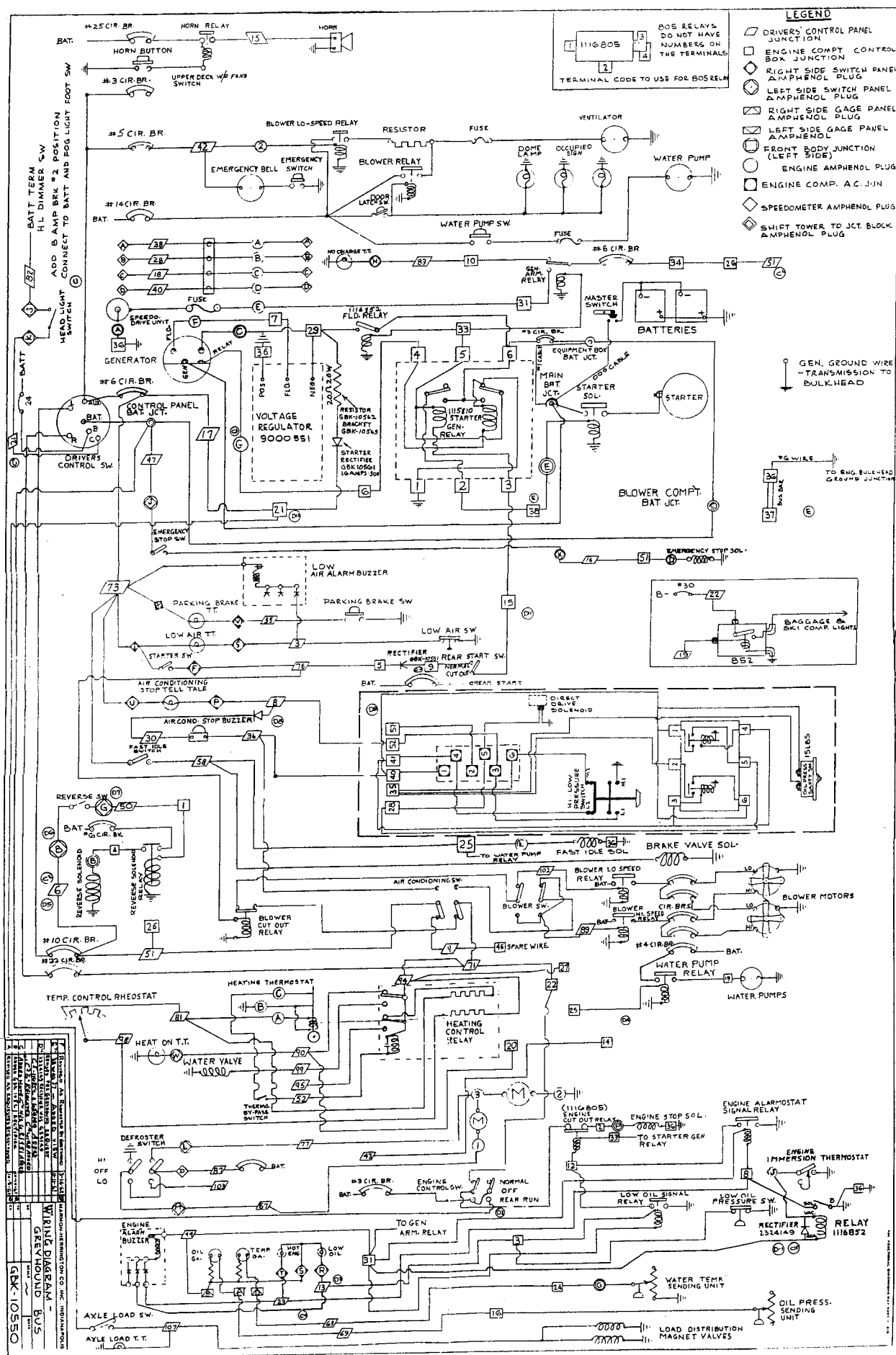
Identical flange yokes are used on both ends of the propeller shaft assembly.

SPECIFICATIONS

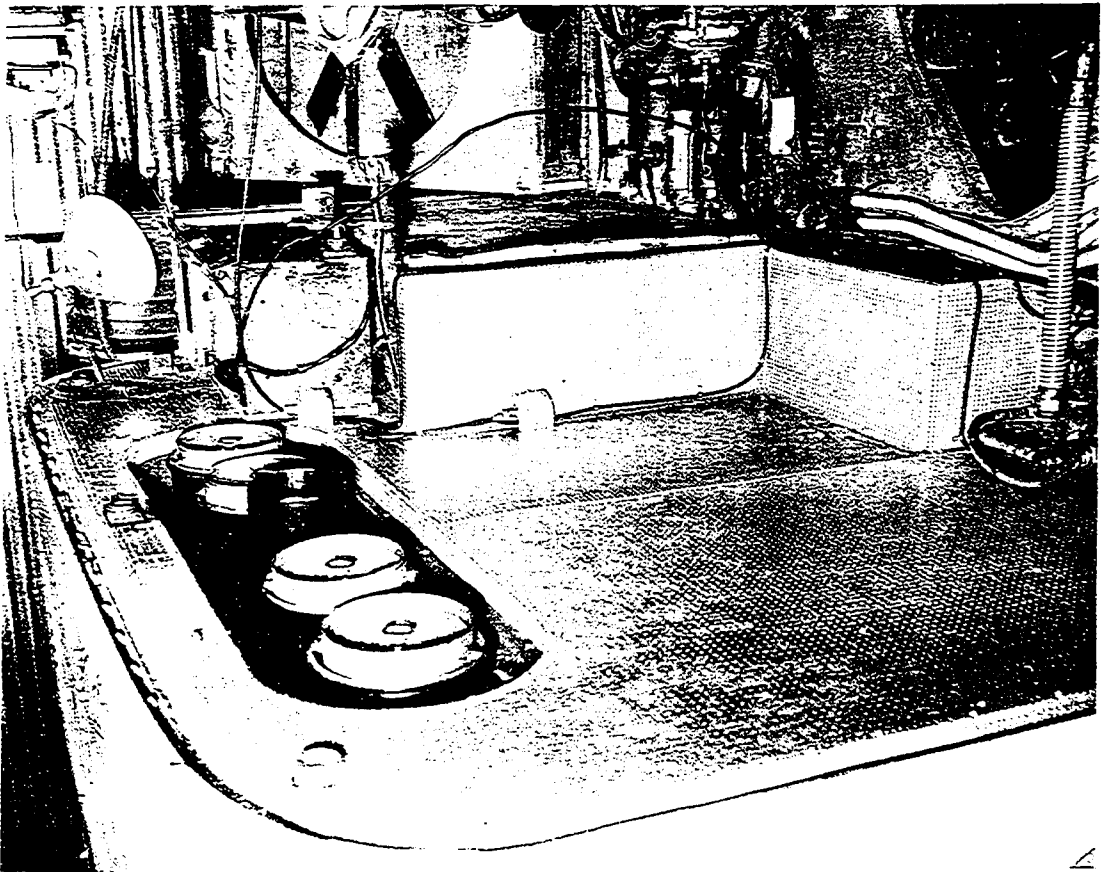
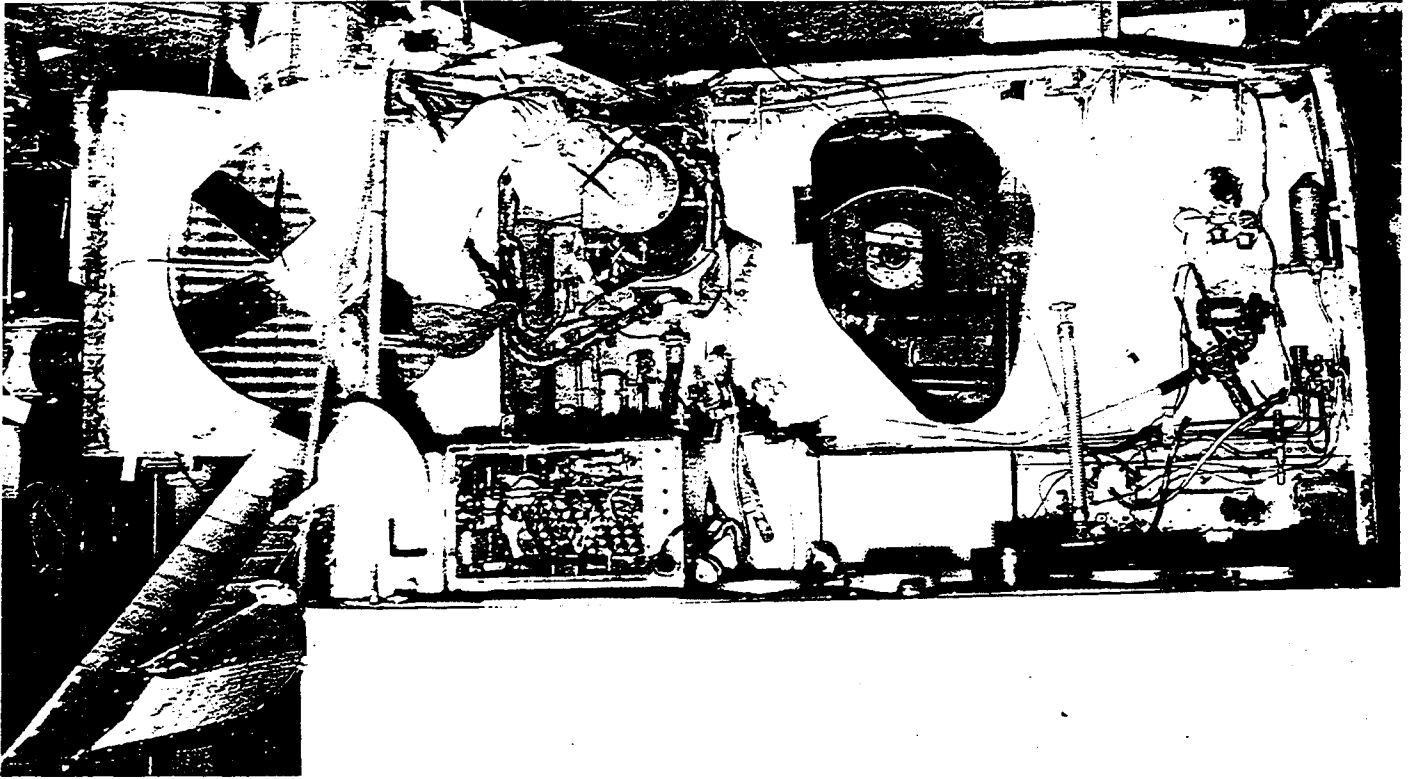
Universal Joint (Slip Joint End)	1801
Universal Joint (Fixed Joint End)	1808
Shaft Diameter (Stub)	3"
Journal Bearing Surface Diameter	1.6875
Bearing Rollers	
Number of Rollers	45



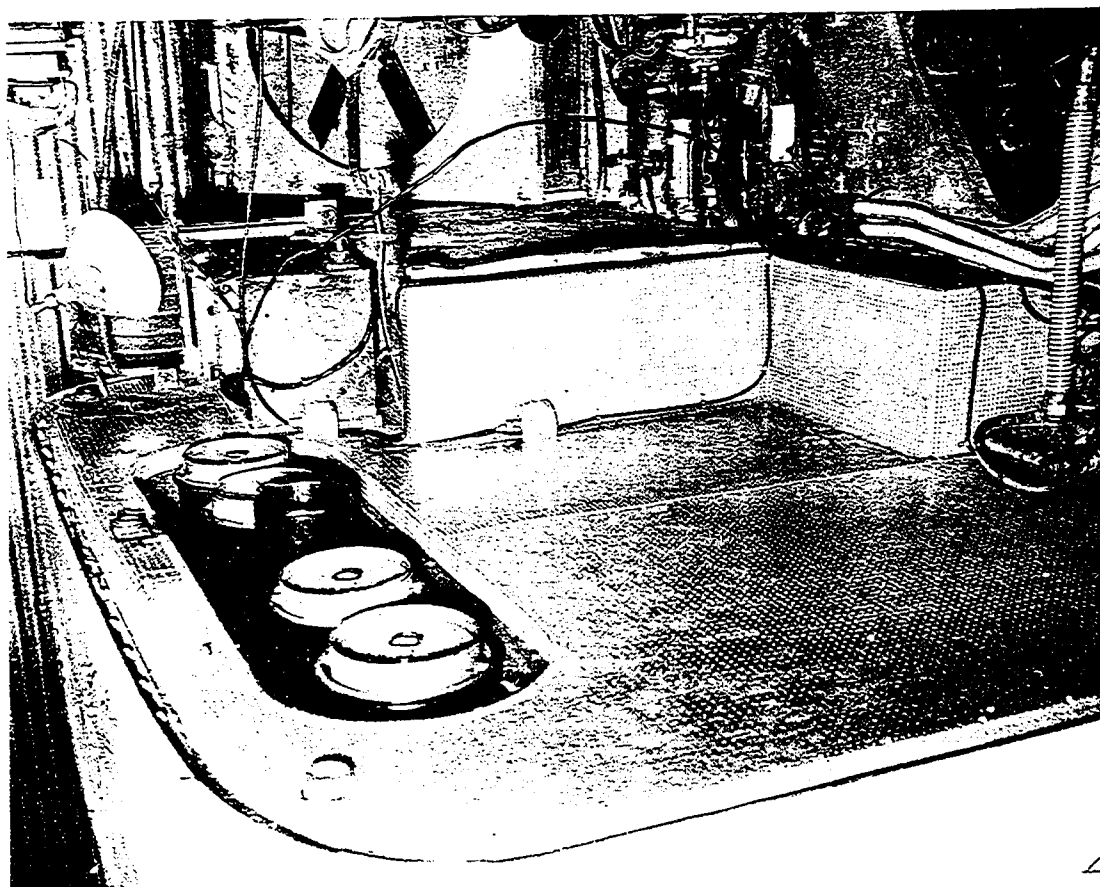
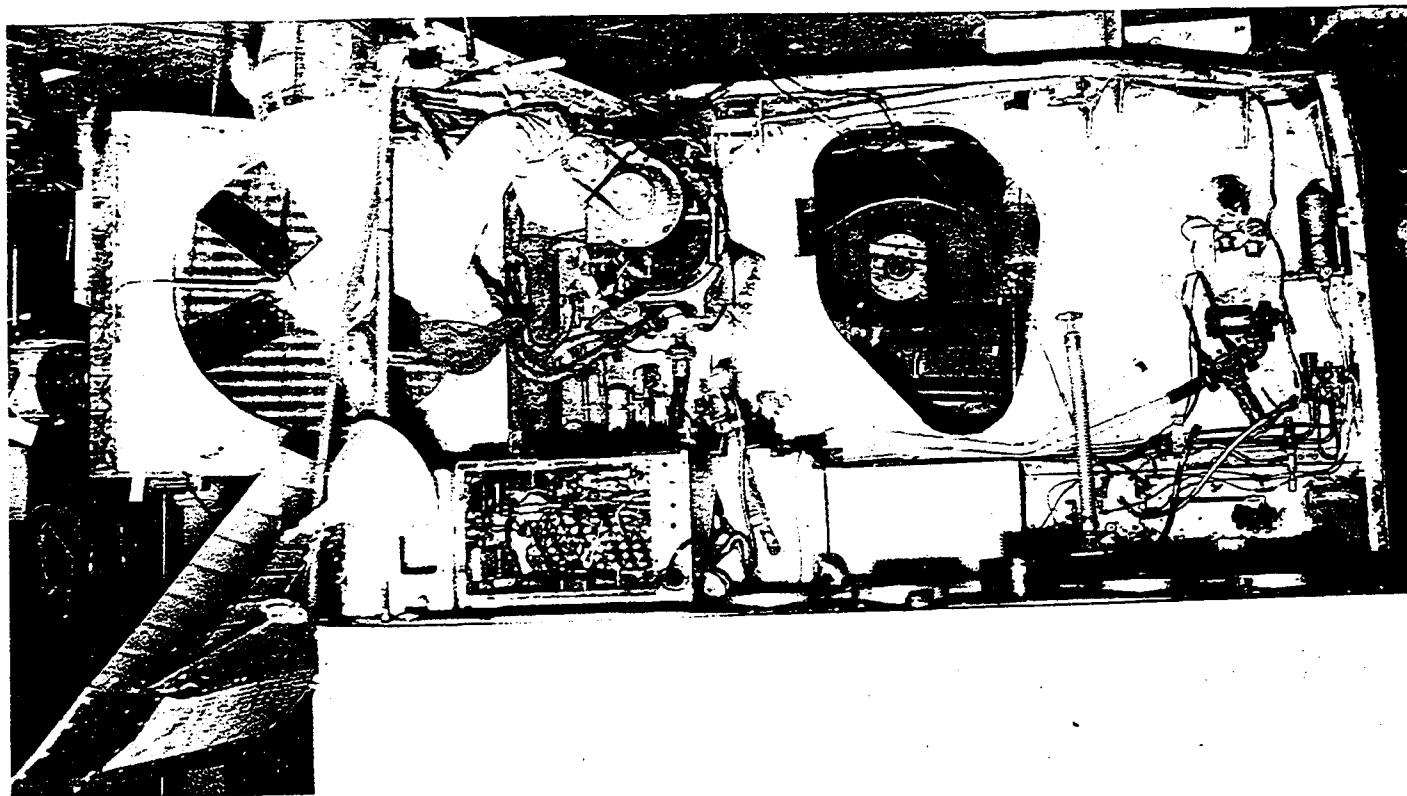


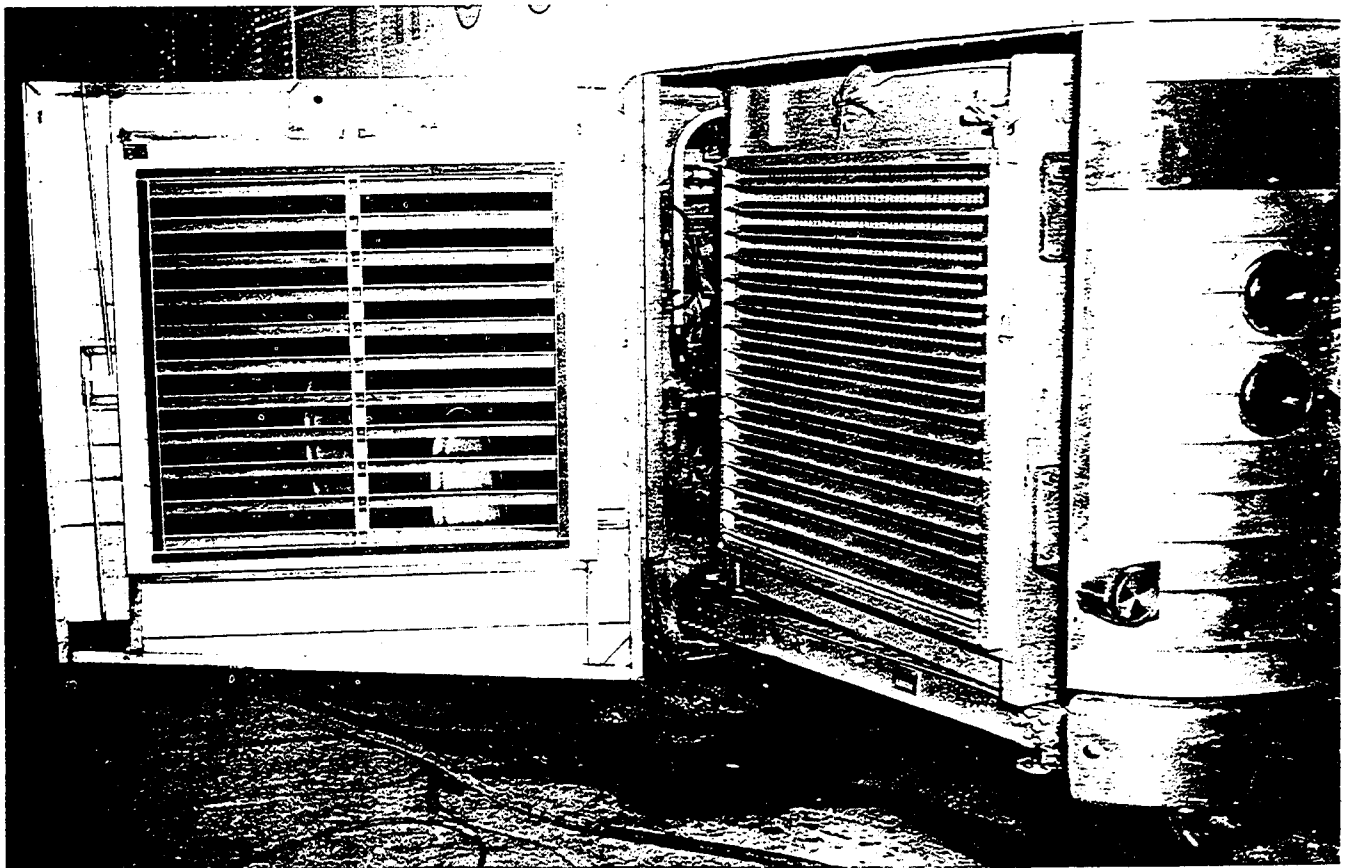
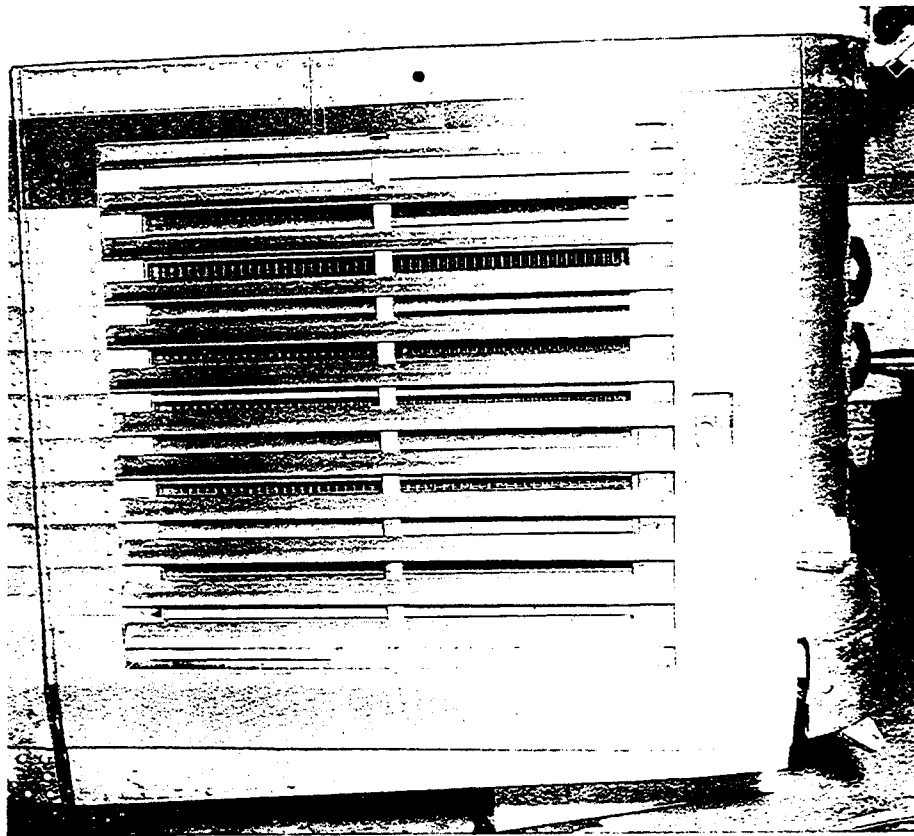


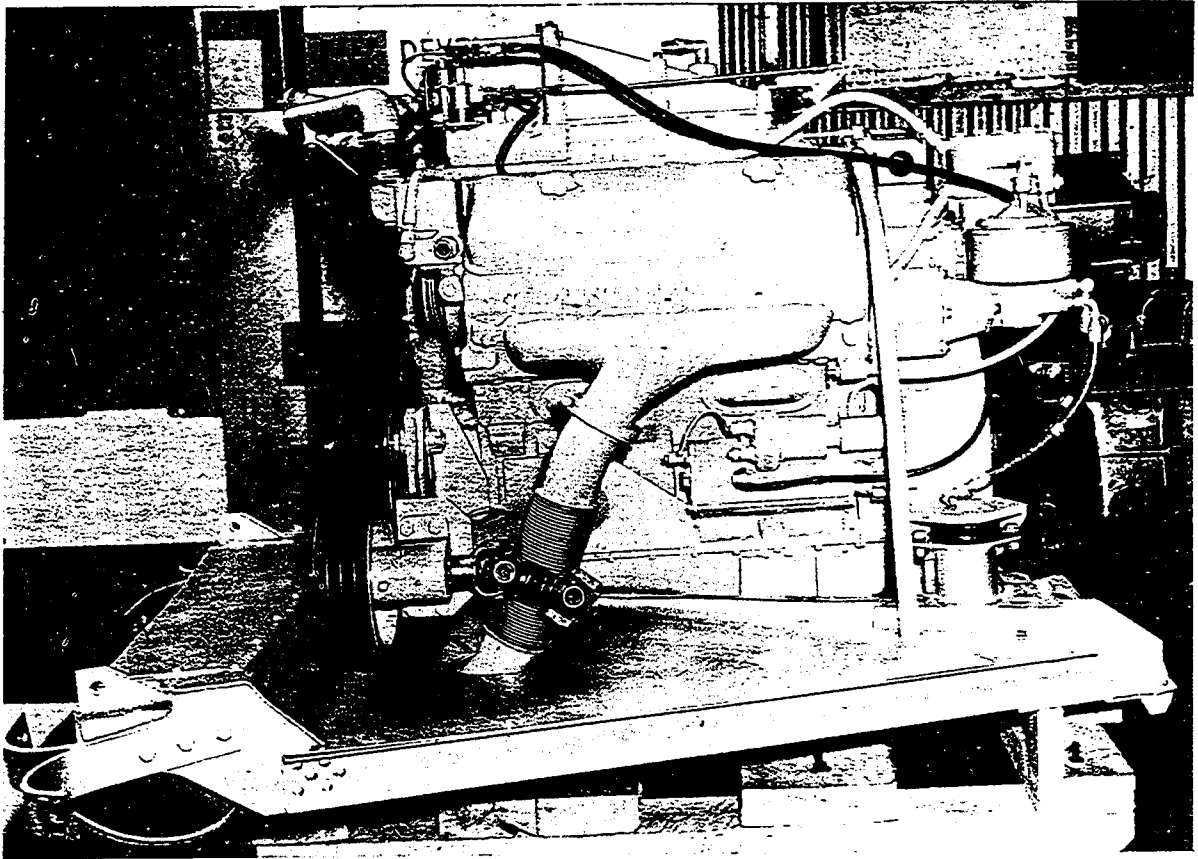
## **REFERENCE PHOTOGRAPHS**



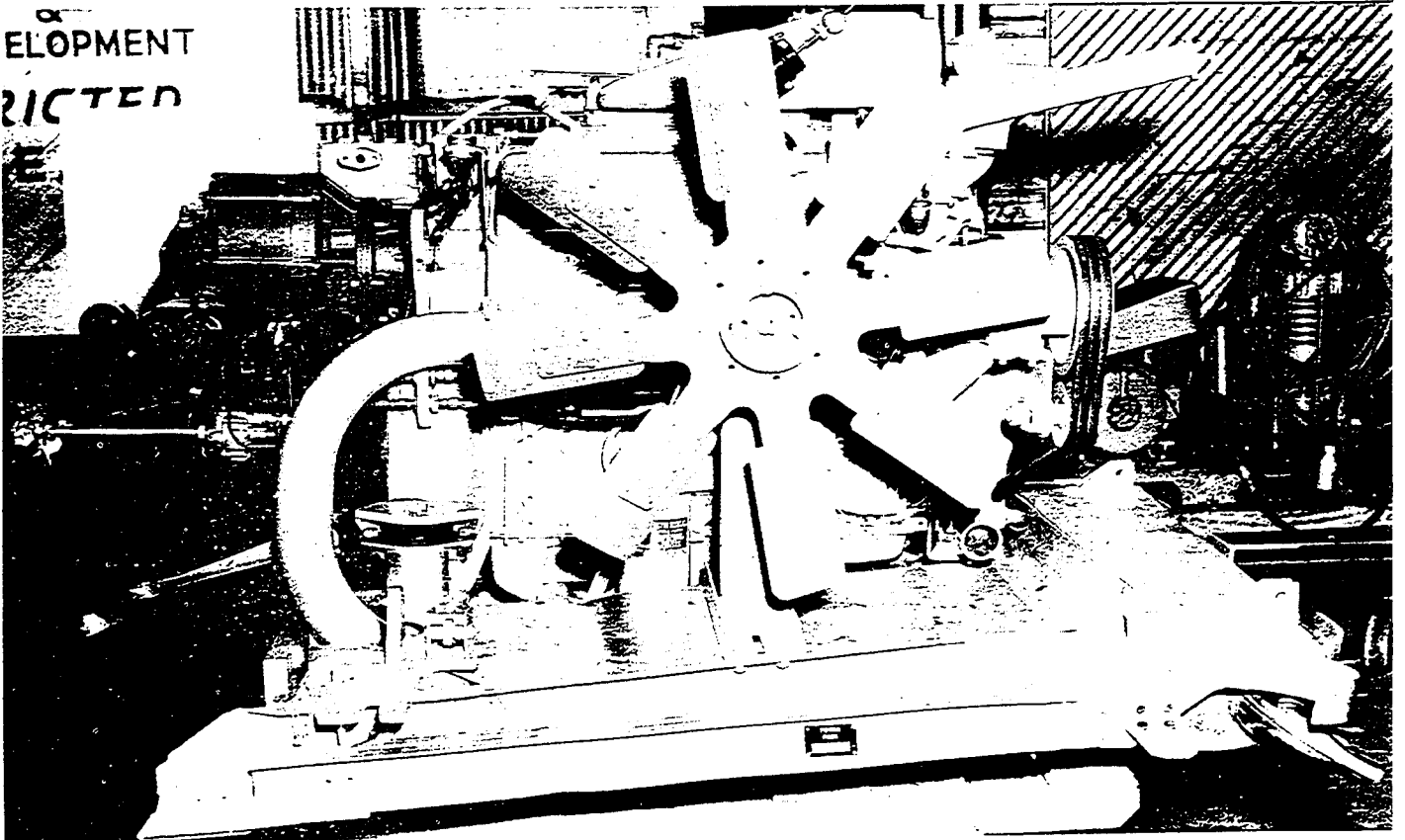


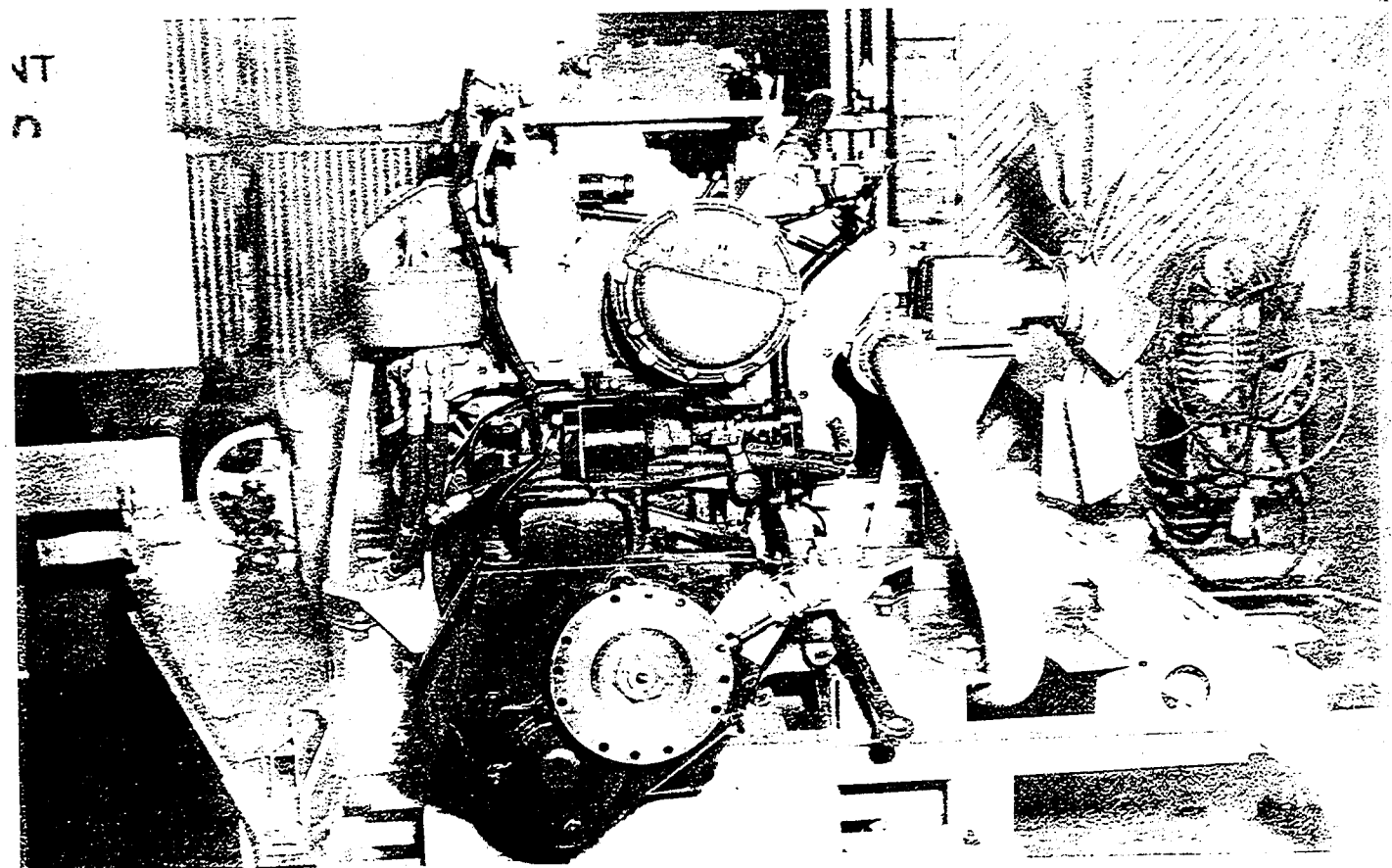
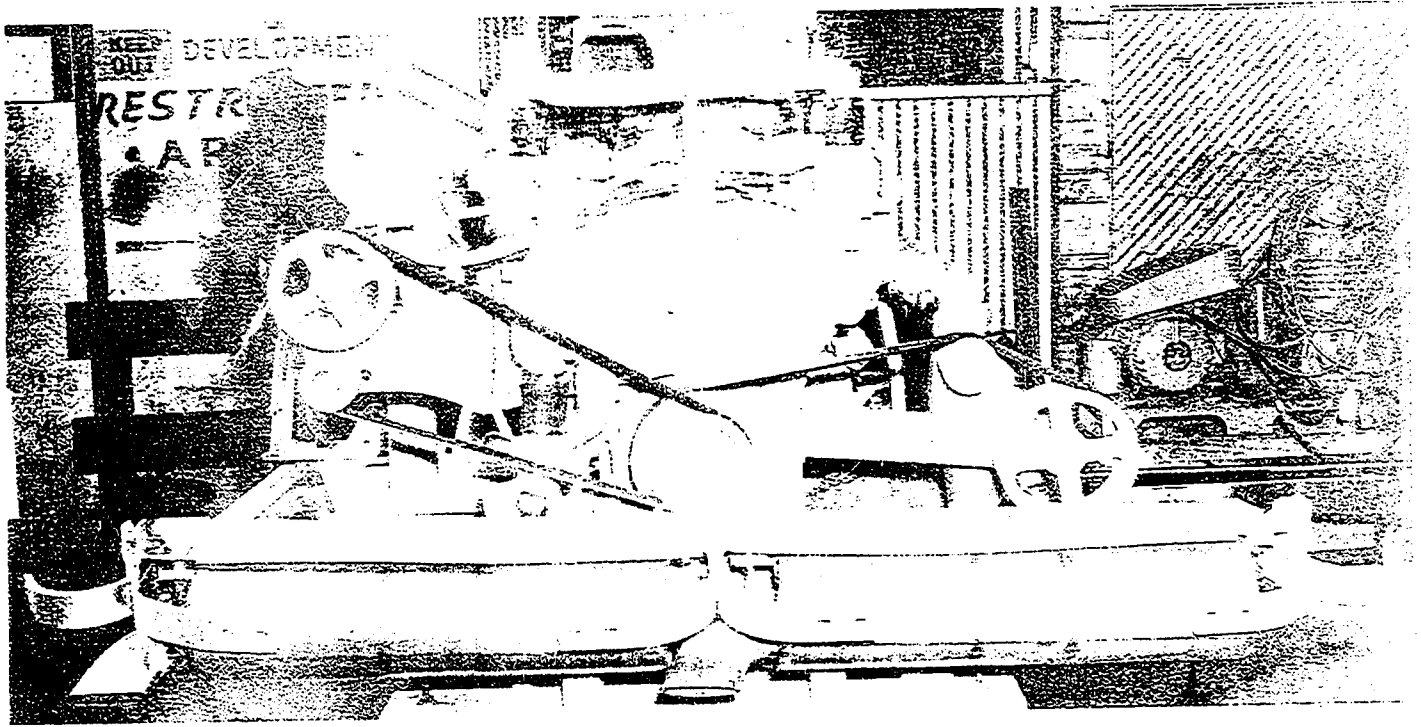


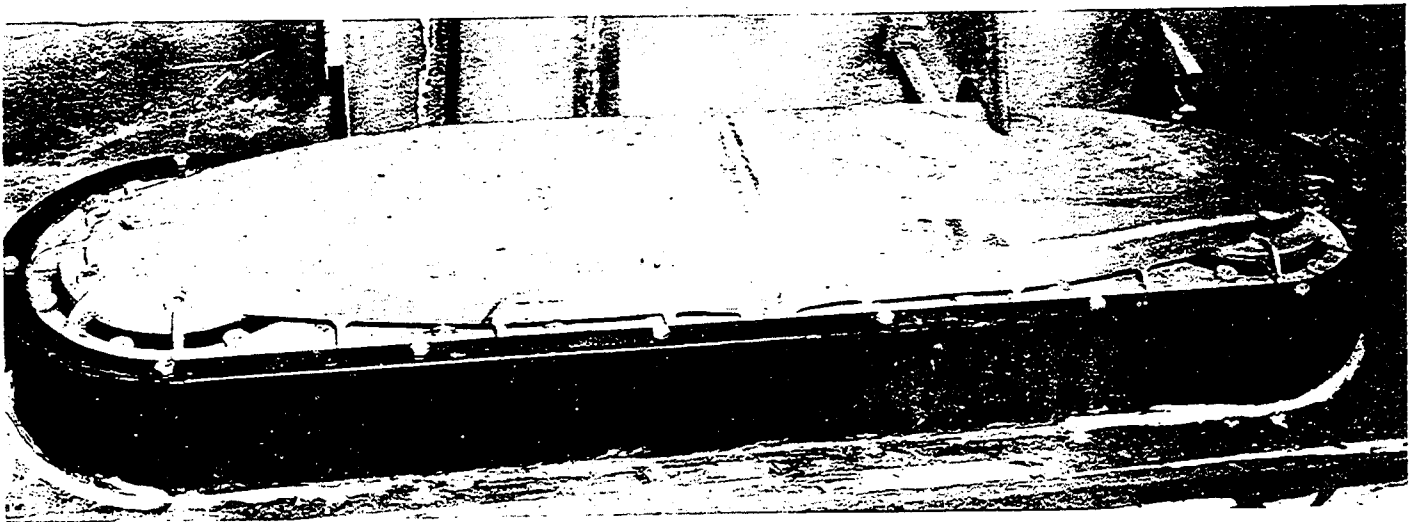
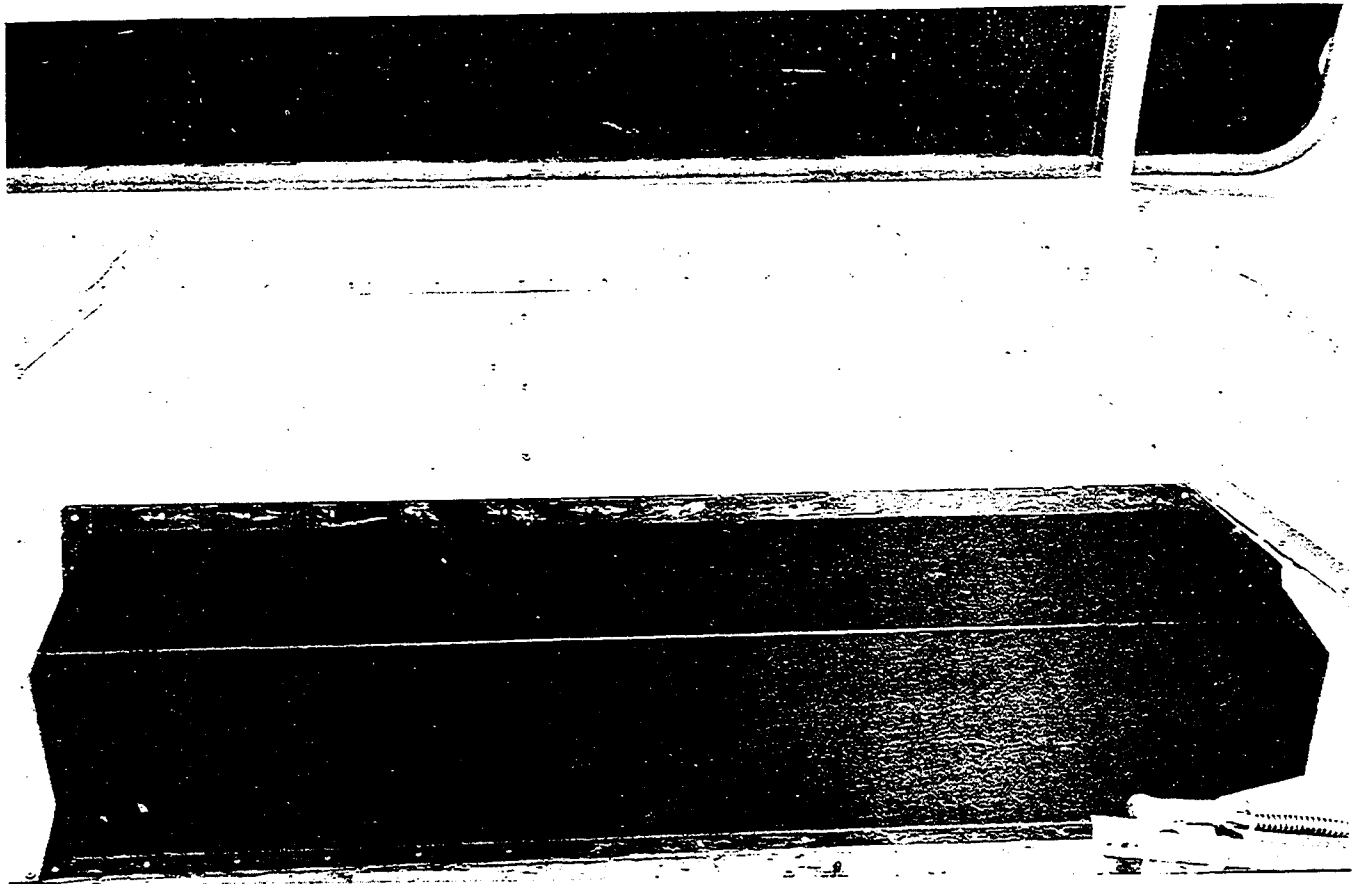


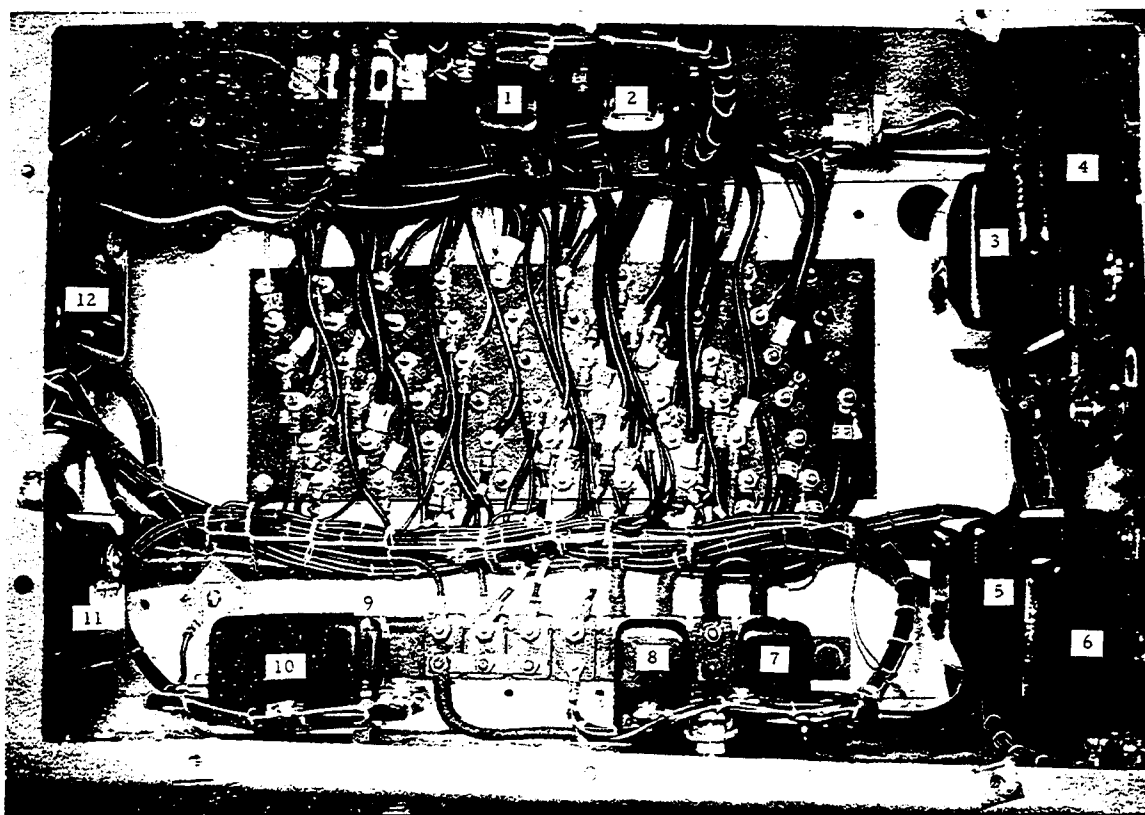
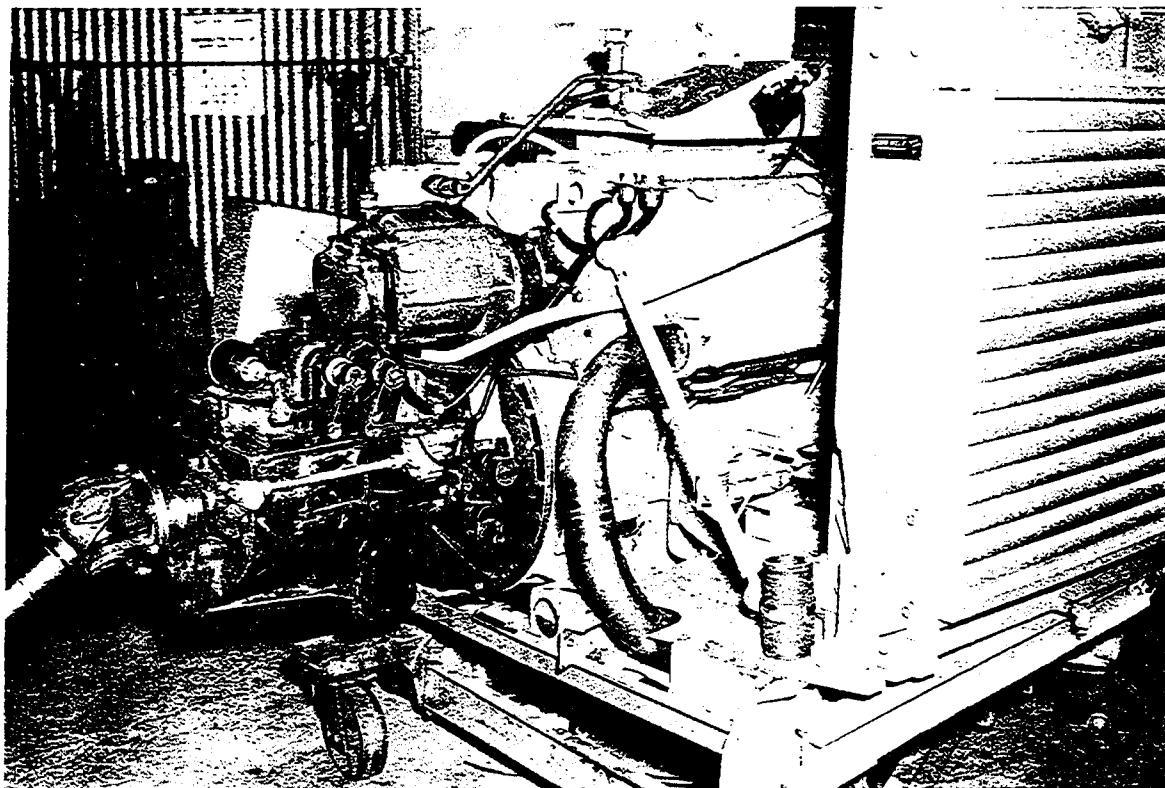


DEVELOPMENT  
RESTRICTED









- |                              |                          |
|------------------------------|--------------------------|
| 1. 852 Field                 | 7. 852 Water Pump        |
| 2. 797 Gen., Speedo. & Pilot | 8. 852 Low Oil           |
| 3. 899 Interior Lights       | 9. 852 Alarmstat         |
| 4. 805 Engine Shut Down      | 10. 852 Hot Engine       |
| 5. 899 Reading Lights        | 11. 899 Air Conditioning |
| 6. 852 Reverse Shift         | 12. 810 Starter          |

